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Concrete

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OCTOBER, 1935

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Predicts Great Activity in Home Building

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PETER GRIMM, well-known New York real estate operator who has been drafted to take charge of the federal government's great home-building program, predicts home-building activities of boom proportions in 1936—an activity which is clearly foreshadowed by the surprising recovery in home construction this year.

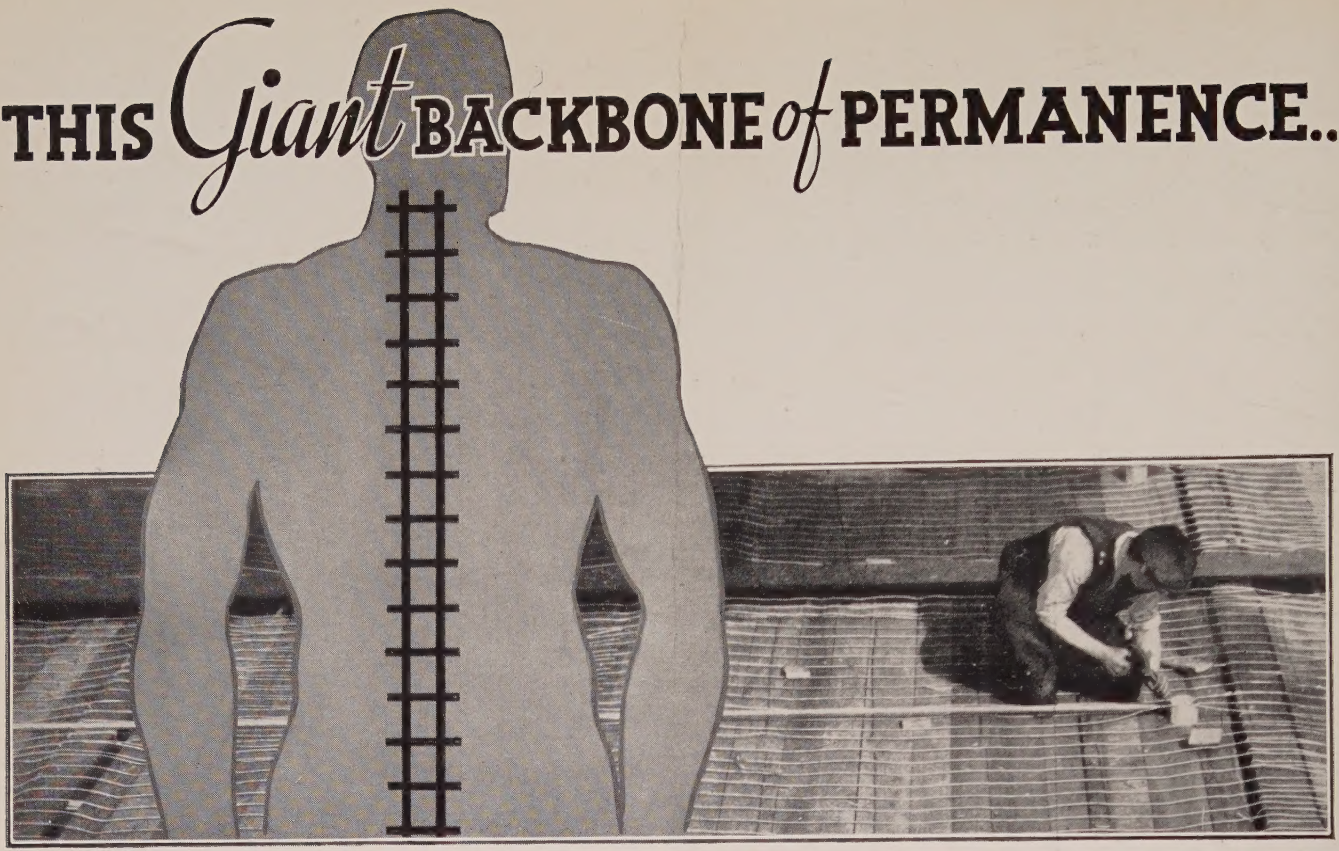
¶ Mr. Grimm is in a position to judge of things in the making. Aside from his outstanding experience as a real estate operator, his office in Washington is the clearing house for the activities of the Home Owners' Loan Corporation, for the Federal Housing Administration, and for other governmental building interests.

¶ To this he adds the advantage of personal contact with manufacturers of building materials and supplies, and with bankers and insurance companies.

¶ Mr. Grimm also holds out the promise of the gradual withdrawal of government money from direct home-building activities. "The peak of federal financial home aid is over," he is quoted as saying. "All the people with whom I have talked say that the period of stress is over and that private capital is now flowing back into construction and loans."

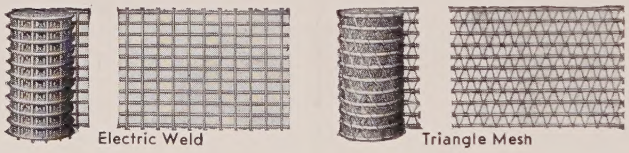
¶ Here is more support for the widespread belief that we have actually entered the earlier stages of a period of great activity in construction.

THIS Giant BACKBONE of PERMANENCE..



..IS EASY TO HANDLE

FURNISHED IN ROLLS OR SHEETS



BUILD for tomorrow—but in building for the future, do not overlook today's need for speed and economy in floor slab construction. In this connection—you will find American Steel & Wire Company Wire Fabric the ideal reinforcement material. Available in rolls—it is exceptionally easy to handle—and keeps labor costs down to a minimum. This Wire Fabric—of highest quality and perfected design—reinforces the concrete slab in every direction. It provides continuous action from one end of the structure to the other—plus high elastic limits and ultimate tensile strength due to cold drawing. It is truly called "The Giant Backbone of Permanence." Interesting literature is available covering the use of this material in the nation's leading structures. This—along with technical data—will be forwarded on request.

AMERICAN STEEL & WIRE COMPANY
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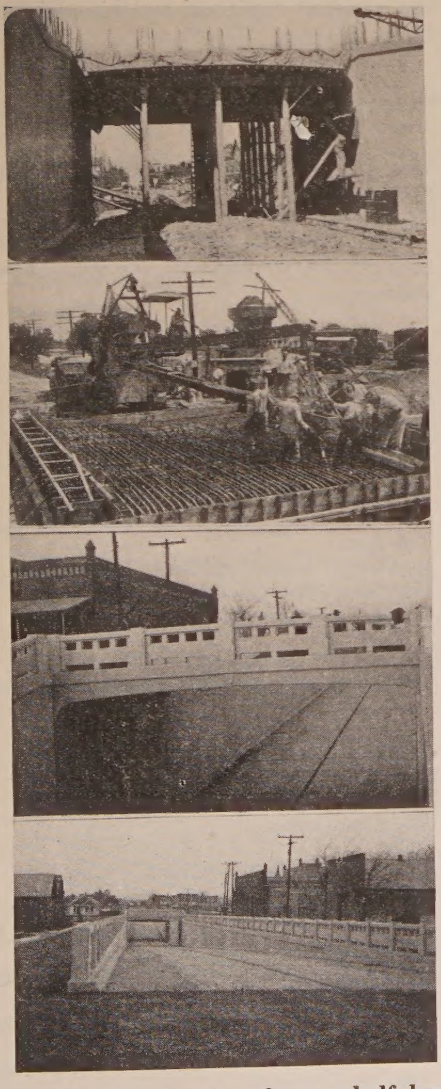
Vol. XLIII, No. 10 Concrete October, 1935

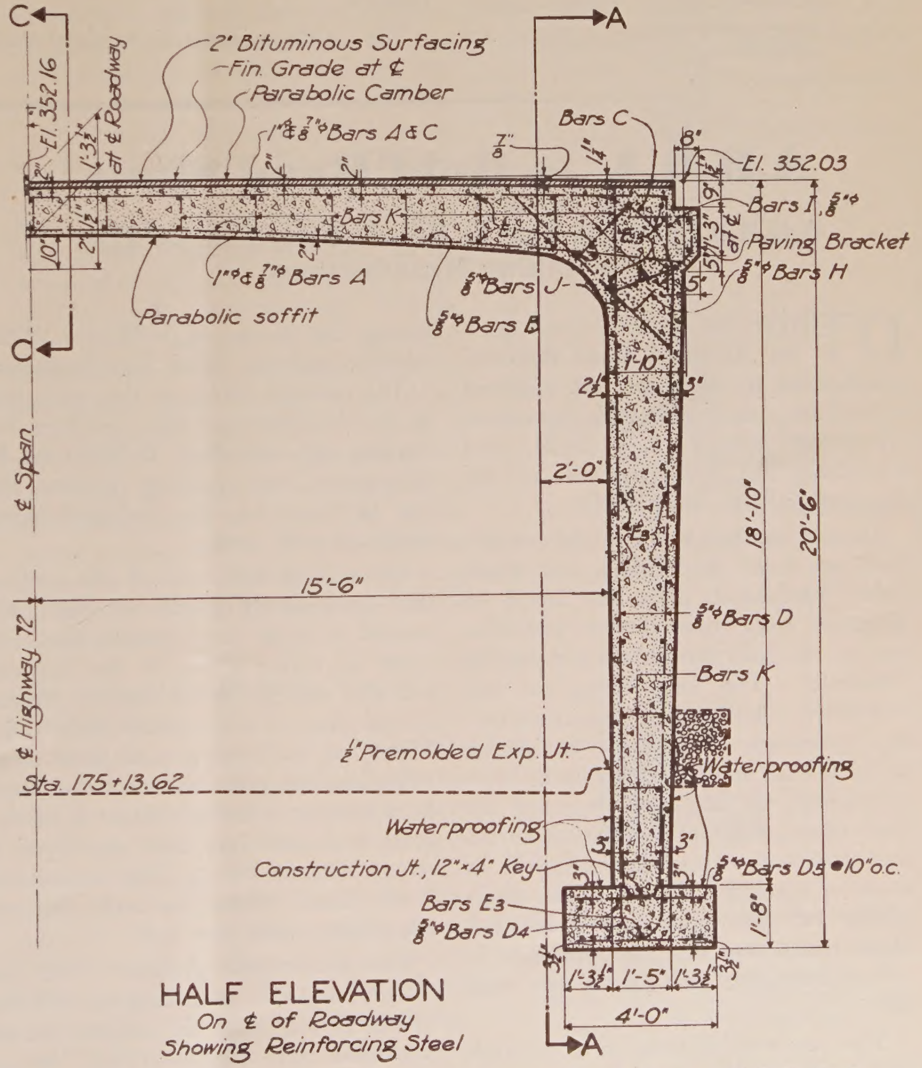
First Rigid-Frame Highway Bridge in Texas

Grade-Separation Structure at Schulenburg Built at Low Cost —Shallow Depth of Bridge Structure Reduces Gradients of Separated Highways

By G. G. WICKLINE
Bridge Engineer, Texas State Highway Department, Austin, Texas

THE State Highway Department of Texas has recently completed its first rigid-frame reinforced concrete bridge for a highway grade-separation structure to carry traffic on one of the main streets of Schulenburg, the street being parallel to the main line of the Southern Pacific Railroad. This new overhead crossing passes over the approach to the underpass where Highway 72 is carried under the Southern Pacific Railroad tracks. The new structure has a clear width of roadway between curbs of 24 ft. The span length between faces of pier walls is 31 ft.





The line drawing shows a half longitudinal section of rigid-frame highway grade-separation bridge at Schulenburg, Texas. Other pictures (top to bottom) show (1) forms, shoring, and protecting tarpaulins to aid curing; (2) rigid-frame reinforcement and placing of concrete; (3) close-up of completed bridge; and (4) underpass of State Highway No. 72

Rigid-Frame Type Selected

Alternate plans were prepared for a concrete girder type of bridge and a typical rigid-frame concrete slab bridge. A rigid-frame type for this location appeared to be well adapted, as it would give a shallower depth between grade line of street and under-clearance of slab, thereby reducing the hump in the grade line and the street. This was a desirable feature to be accomplished.

Alternate bids were received and it was found that the rigid frame was about $283 lower in cost than the strictly concrete girder type. On account of the desirable feature of reducing the hump in the street grade as much as possible, the contract was awarded for the rigid-frame type. The cost of the type selected was $2,754. This was exclusive of the bituminous surfacing. The bid on the reinforced concrete girder type superstructure was $3,037. The contract was awarded in connection with the Southern Pacific underpass project and necessary roadway approaches. The work was completed for the entire project about February 1, 1935.

Standard Highway Loading

The line illustration shows the general dimensions of the structure and the arrangement of the reinforcing steel.

A standard state highway department loading which corresponds to the American Association of State Highway Officials' Specification for two H-15 ton trucks was used. The unit stresses were that of the State Highway Department of Texas, to provide maximum unit stresses (on concrete) of 650 lb. per sq. in.; and on reinforcing steel, 16,000 lb. per sq. in. A design was prepared in accordance with the slope-deflection method, and was checked by the method outlined in the handbook of the Portland Cement Association, which is an adaptation of the method developed by Prof. Hardy Cross of the University of Illinois.

The halftone illustrations show various parts of the construction work, including the arrangement of the reinforcing steel and the form work, and a view of the completed structure. This structure is easily viewed from the car windows of the Southern Pacific trains traveling between San Antonio and Houston. It is on the north side of the track, east of the depot at Schulenburg.

No special difficulties were encountered in the building of this structure. It presents a very neat appearance, indicating that the concrete placed into the project was of excellent quality.

Acknowledgments

The design for the rigid-frame structure was prepared in the bridge division of the State Highway Department at Austin, by A. B. Staubach, under the general direction of G. G. Wickline, bridge engineer.

The engineering supervision of construction was in charge of R. E. Schiller, resident engineer, and his assistant, H. P. Krause.

A.R.B.A. to Hold Road Show

A.R.B.A. Officials Vote in Favor of Big Exhibit After Consulting Manufacturers

DEFINITE decision has been made by the American Road Builders' Association to hold an old-fashioned road show concurrently with the annual convention next January 20-24, and Cleveland has been selected as the Convention-Road Show city.

Formal announcement of the convention and road show plans was made from Washington after the board of directors acted upon the recommendation of the joint convention and exhibit committee. The joint committee had conducted a poll among manufacturers and producers of highway equipment and materials and found sentiment overwhelmingly in favor of resuming the road show. Many of the manufacturers and producers expressed themselves in favor of Cleveland because of the availability of that city's new Exhibition Hall, which was designed particularly to accommodate exhibits at the road show.

The new exhibit area, in one building, is 461 ft. long and 365 ft. wide, making the total exhibit space available 160,000 sq. ft. This very nearly equals the space area occupied in Cleveland during the shows of 1928 and 1929, which completely filled three buildings.

The railroad siding at the north end of the building provides facilities for loading and unloading. Exhibits can be transported into position without the use of elevators, the building being equipped with ramps.

Officials of the A. R. B. A. declare that preliminary plans are well advanced to hold a convention that will cover all major phases of the highway industry and profession, and to present a road show of all-inclusive magnitude. There has not been a road show since 1933, and the great advances that have been made in technical phases of equipment and materials have developed a strong demand for an "Old Fashioned Road Show" where the trade can see everything under one roof.

The Convention program, like the Road Show, will be in keeping with the "1936 model," and the subject matter scheduled for discussion will be as broad in scope as the whole industry and profession, with nationally-known engineers, highway officials, contractors, manufacturers, producers, and others who know highways and streets leading the discussions.

Following is a partial list of the subjects to be covered in the convention sessions:

GENERAL

Federal highway appropriations
National highway legislation
Modernizing highways and streets
Grade-crossing elimination
Conservation of gasoline tax

COUNTY OFFICIALS

Building public opinions for secondary road program
Legislation, finance and administration
Regional survey and plans
Design and construction
Maintenance
The value of organization
Use of publicity for county highway program

CITY OFFICIALS

Street railway and pavement construction
Federal aid to municipalities
Design, specifications
Grade crossings
Traffic

CONTRACTORS

Highway revenues for highway construction
The broadening of the contractor's market by a continuation of the highway program
The economic value of federal appropriations for highways
The contract system vs. the day labor or force account system
Government trend in hand labor and machinery requirements

The complete Convention-Road Show program is being drafted, and will be announced well in advance of January.

Combine Stone and Concrete in FIREPROOF HOMES

Outer Part of Wall Carries Floor and Roof; Floors Support Inner Part of Wall—Also Applicable to Concrete Ashlar

A NEW type of fireproof home construction developed in Milwaukee in recent years by John D. Edwards & Associates, Inc., builders of fireproof homes, has begun to attract well-deserved attention, not only among contractors, but among architects, concrete products manufacturers, and prospective home owners.

Outer Wall of Stone or Ashlar

While the outer part of the exterior walls of all the homes thus far built in accordance with this system is of squared stone, other high-grade building materials such as concrete ashlar units could be employed with equally effective results. In Milwaukee and vicinity, squared stone of random sizes, all ready to be placed in the wall—exactly as shown in the illustrations—can be obtained at the unbelievably low price of $3.50 per ton, delivered to the construction site. One ton of this stone is sufficient to lay 24 sq. ft. of 8-in. wall. In consequence, the actual cost of the stone, delivered to the job, is about 15 cents a sq. ft. of wall area for the 8-in. wall.

Must Place Masonry Rapidly

Few localities, however, have available a natural stone of this character at this extremely low price. Accordingly, in most localities random or coursed concrete ashlar units would seem to be the logical material for the outer, or 8-in. thickness, of exterior walls, inasmuch as the material employed must be a kind that can be laid up rapidly if the cost of construction is to be kept at a low figure. Dressed or cut stone would not do, because the cost of mason labor would be too high. The same objection applies to brickwork, to a smaller degree.

Concrete Floors, Terrazzo Finish

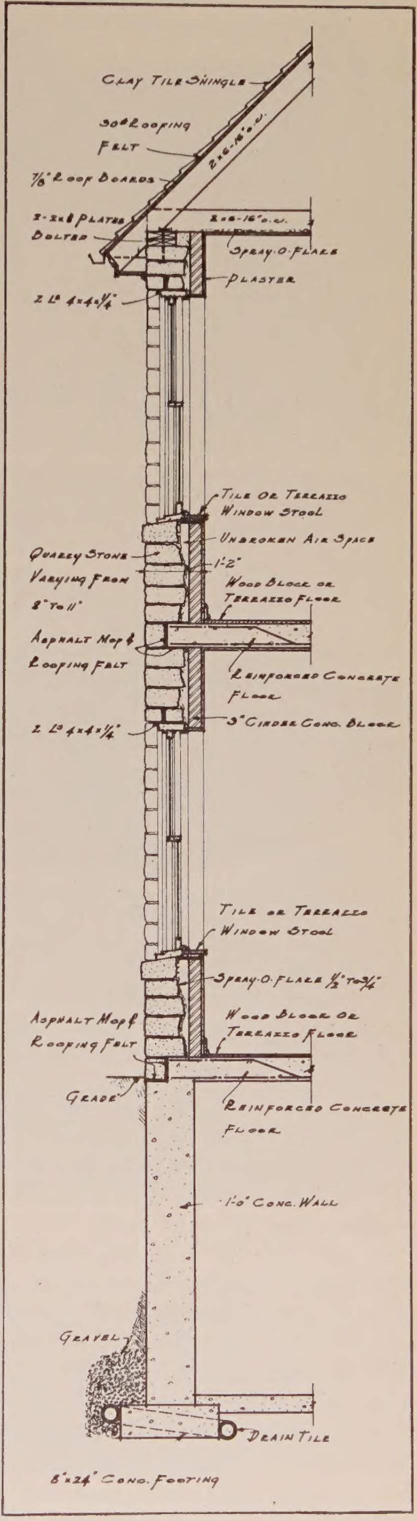
The line illustration shows a typical section of wall construction, and the type of floor construction built by the Edwards company in nearly all the homes—large or small—thus far built. The floor construction, as shown, consists in most cases of a 6-in. reinforced concrete slab, with a floor finish of terrazzo. This in itself is a most commendable and unusual detail, especially for the smaller homes; but the fact remains that this floor construction is economical, and in every respect desirable for the small home no less than for the mansion. At all the completed homes visited by a representative of CONCRETE, the housewives commented on the ease with which the terrazzo floors are kept clean.

The exterior wall construction, as developed by John D. Edwards & Associates, is of unusual interest. As the line drawing shows, there is an outer wall of 8-in. nominal thickness, an air space of 2 to 4 in., and an inner wall of 3-in. cinder concrete units. For the outer wall, as previously explained, squared stone was employed in all the homes now built or under construction in and around Milwaukee. Because of the presence of the air space, however, the actual thickness of the wall may be anywhere from 8 to 11 in. That is, the stones are allowed to protrude into the air space for as much as 3 in., so long as actual contact with the inner wall is avoided.

No Connection between Wall Sections

With the outer part of the wall laid up, the reinforced concrete floor slab is placed, supported by this 8-in. outer wall, and the inner face of the wall is sprayed with a thick coat of Spray-O-Flake, the commercial name of a mixture of paper and bituminous material that is applied with a compressed air-driven spray gun. The purpose of this coating is, of course, that of insulating and waterproofing the wall. It is sprayed on to a thickness of ½ to ¾ in.

Next, the terrazzo floor finish is placed, before the inside partitions are built. The structural significance is that *the 3-in. inner wall is supported directly by the reinforced concrete floor slab.* This may readily be seen by referring to the line drawing. Because of this arrangement—the outer wall supporting the floor slabs and roof construction, and the floor slabs supporting the inner wall—no connection whatever appears



The outer wall carries the floors and roof; the floors support the inner wall. No connection between the wall sections

Whether for mansions or for dwellings of ordinary size, this economical construction produces a wall of the highest type, both as to utility and appearance

between the two wall sections. This total absence of ties, struts or other connections between the outer and inner wall sections prevents frost or moisture from reaching the inner wall.

It will thus be seen that the 8-in. outer wall is the bearing wall that supports the entire floor and roof construction, while the 3-in. inner wall is a nonbearing wall resting on the concrete floor slabs.

In the Milwaukee homes visited by a representative of CONCRETE, 3-in. cinder concrete units were used for the inner wall. Similar units made of other light-weight aggregates such as haydite and processed slag would also be suitable for this purpose, the object in view being to create a damp-proof insulating chamber and a sound-absorbing surface that also forms a good base for plaster, cement paint or other interior finish.

A Few of Many Examples

Several homes recently built in or near Milwaukee are shown in the halftone illustrations. The larger building, located in the highest-class residential section of Milwaukee, was built two years ago. It has the typical wall construction, with reinforced concrete floor slabs and a mastic floor finish. The entire home is air-conditioned.

The smaller home in the illustration is the Vogel residence, just outside the city limits, in Wauwatosa. It is a 6-room home with a complete basement, of the typical wall construction shown in the line drawing, a clay tile roof, and with a terrazzo floor finish throughout, placed on a 6-in. reinforced concrete slab. Partitions are of 4-in. cinder concrete units. The building is 28 by 45 ft. in general dimensions, and was built this year at a cost of $5,800 complete, including the cost of plumbing, heating, wiring, built-in equipment, fireplace, interior decorating, copper screens, storm sash, concrete walks, and grading and seeding of the lawn.

Cost Unusually Low

Another home—a 5-room one-story building at 2157 South 84th Street, West Allis, Milwaukee, recently was built at the low cost of $4,975, this price also having included the plumbing, heating, wiring, decorating, built-in equipment, fireplace, copper screens, storm sash, concrete walks, and landscaping. This building is 28 by 40 ft. in general plan, with a full basement, including a finished recreation room. The living room, on the ground floor, is 13 by 20 ft. in plan. In this building, as in others, floors are of terrazzo throughout, on a 6-in. reinforced concrete slab, partitions are of 4-in. cinder concrete units, and the walls have the usual thickness made up of the 8-in. outer wall of squared stone, the 3-in. inner wall of cinder concrete units, and an air space of 3 in. The outer wall was insulated with the mixture of paper and bituminous material previously described. The roof is of the highest grade of clay tile.

Certain features of this wall construction are covered by patents held by John D. Edwards & Associates. Architects and builders wanting further information are invited to write to the company at 326 West Brown St., Milwaukee, Wisconsin.

Modernization Loans Increasing

DURING the week ending September 14, a record number of modernization loans under $2,000 were reported to the Federal Housing Administration. There were 25,172 loans worth $8,100,494. This record week is far ahead of the old record, established the week ending August 31, of 19,550 loans for $6,215,023. This brings the total number of insured modernization and repair notes under $2,000 recorded by the Federal Housing Administration since the beginning of the program to 401,292, valued at $149,111,551.

The total volume of modernization and repair work stimulated by the program far surpasses the loans made. It is estimated that property owners of this country have spent, since August 1, 1934, $840,000,000 as a direct result of this program.

Farms Being Modernized with Concrete

Farm Owners Taking Advantage of Federal Housing Administration's Insured Loans—Big Market for Products Industry and Concrete Contractors

A BIG market for the concrete products industry and for concrete contractors has been opened up because of the energy being displayed by farm owners—especially by owners of dairy and fruit farms—in taking advantage of the farm modernization credit plan of the Federal Housing Administration.

Thousands of farmers have taken advantage of this plan to repair, rebuild or improve their homes, barns, other service buildings, and equipment. Insured loans have increased steadily each month since the Federal Housing Administration started its farm modernization program. With good crops and high market prices, it is predicted that spring will see farmers spending several million dollars a month on their property and equipment.

Dairymen Lead in Modernizing

Dairymen, as a class, are the largest farm group using this credit, extended by banks and other private financial institutions, and insured by the Federal Housing Administration. The general drive on the part of city and state health authorities to compel milk producers to bring their barns, milk houses and sanitary facilities and equipment up to the standards demanded by law is responsible for a heavy increase in the use of concrete and concrete products.

Health Authorities Interested

Health authorities, knowing that thousands of milk producers have not heeded their initial warning—that their market will be shut off unless they comply with the regulations—are preparing to make a second visit to dairy farms during this fall. Producers, realizing the inspection is close at hand, are inquiring into the *Modernization Credit Plan.* In consequence, the use of concrete and concrete products in agricultural districts should be materially increased before the present year is out.

Milk Houses and Greenhouses

Concrete blocks are gaining in favor, especially for milk house construction. Agricultural college engineers in dairy states have drawn sets of plans for milk houses costing around $200. Buildings of this nature, made of concrete blocks, are becoming popular. The inside walls are comparatively smooth and easily washed—a sanitation requirement. Milk-cooling and utensil-washing tanks, as well as floors, are being built of concrete.

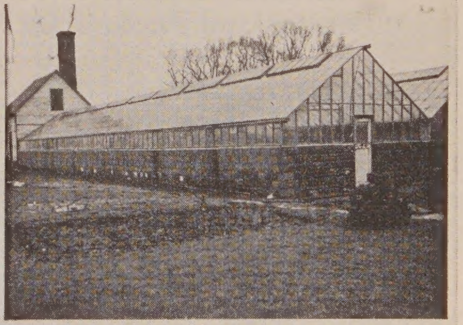
Greenhouse owners are finding concrete blocks not only a saving in maintenance, but foundations and side walls so constructed have been the means of reducing winter fuel bills by as much as 30 per cent, in addition to assuring hardy plants in low temperatures. This at least, is the experience of Paul Schmidle, of Ebenezer, N. Y., who replaced the wood side walls of his greenhouse with concrete blocks, as shown in one of the illustrations. "It saves one-third of our coal expense," he said, "and we have no fear for the plants, even when the temperature gets down as low as 20 degrees below zero."

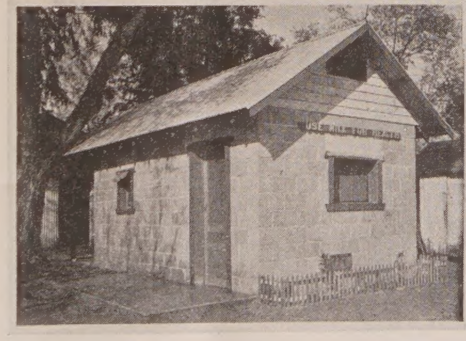
New Foundations

While repairs to service buildings, which include barns and milk houses, is the second most numerous work done with modernization credit funds, one of the 10 highest items of construction work on farms has to do with foundations, both old and new. Concrete is invariably used to shore up faulty foundations of both homes and service buildings, regardless of the original material; and the addition of new rooms and the installation of central heating plants, such as furnaces, are responsible for the digging of hundreds of new cellars. Naturally, concrete floors follow.

Septic Tanks

Farm home modernization, which includes the installation of bath rooms and toilet facilities, is increasing. This is the sixth most popular improvement on farms in the past year. It has improved the demand for concrete septic tanks, with the interests in these conveniences sufficient to indicate a greater





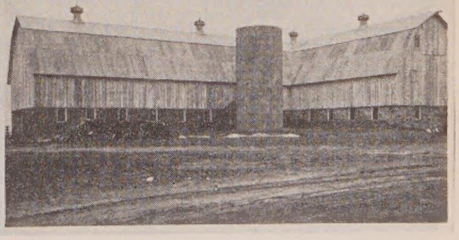


Fig. 1 (Top, left)—A coat of cement paint rounded out the appearance of C. W. Smith's dairy building after he built upper part, to house dairy machinery, with modernization credit insured by Federal Housing Administration.

Fig. 2 (Bottom, left)—A concrete block milk house, built with modernization credit insured by the Federal Housing Administration, met city sanitation requirements and saved market for William Cornu.

Fig. 3 (Top, right)—Greenhouse of Peter Schmidle, Ebenezer, N. Y. New walls of concrete block, built with modernization credit insured by the FHA, made big reduction in fuel bill.

Fig. 4 (Bottom, right)—Concrete block silo, built on 300-acre farm of Alex Broker, near Collegeville, Minn., with loan insured by the FHA, solved winter feed problem.

number of installations next year.

All in all, every sign points to farmers being big users of concrete, cement, and concrete products; but products manufacturers and concrete contractors who wish to participate in this business must get into contact with prospective customers. Banks, operating under the Federal Housing Administration plan, are willing to finance such deals; but the selling must be done by products men and contractors.

A Convention of Demonstrations

Concrete Masonry Association to Hold Unusual Convention in Detroit—To See Actual Plant Operations of Latest Equipment

A MOST unusual convention is the one tentatively scheduled to be held in Detroit on January 21, 22, and 23, by the National Concrete Masonry Association.

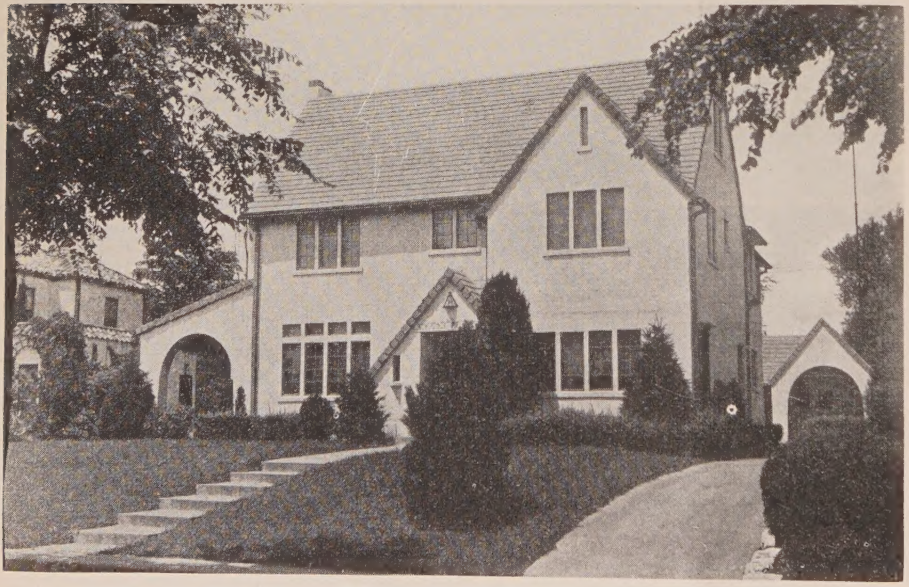
Convention headquarters will be at the Statler Hotel—but only the morning and afternoon sessions of the first day will be held there. On the second day of the convention, buses will take the convention visitors to some of the leading concrete products manufacturing plants, where manufacturers of concrete products machinery will give actual demonstrations of their latest equipment and processes. Thus the visitors will see the newest machinery and equipment in actual operation under actual manufacturing conditions. In this way, products manufacturers may carry home with them some very definite ideas about the performance of the new machines and the new improvements to old equipment.

The third day of the convention will be devoted to an all-day trip to visit some of the outstanding buildings in Detroit and vicinity in which concrete ashlar and other concrete masonry units have played an important part.

A synopsis of the tentative program scheduled for the Detroit meeting will be found on another page of this issue of CONCRETE, in the *News Letter* of D. R. Collins, assistant secretary of the National Concrete Masonry Association. Further details of the convention will be given in following issues of CONCRETE.

Reinforced Concrete House of Ribbed Wall Type

Structural Concrete Roof Slab Coated with Colored Mortar and Marked Off to Resemble Roofing Tile



THE illustration here reproduced shows a monolithic reinforced concrete house built at 6540 Pennsylvania Ave., in Kansas City, about five years ago by A. S. Nachman.

Walls are built in accordance with a method of construction that is similar to ordinary ribbed wall construction, known as the Con-Tee system.

White portland cement stucco was used as the exterior finish, and the interior face of exterior walls was furred and plastered. An unusual feature is the roof, which consists of a reinforced concrete structural slab and a coating of red cement mortar marked off in imitation of roofing tile.

The house is 2½ stories high, contains eleven rooms, and is valued at $20,000. It was designed by Ernest O. Brostrom, a Kansas City architect. H. R. Lewis had the contract for the concrete work.

R. W. Johnson, formerly secretary of the Concrete Reinforcing Steel Institute, Chicago, is now assistant sales manager of the Kalman Steel Company, Bethlehem, Pa.

●

W. S. Thompson has been appointed as secretary of the Concrete Reinforcing Steel Institute, 201 North Wells Street, Chicago, Illinois. He succeeds R. W. Johnson who served the Institute efficiently in a similar capacity and as engineer for a period of over eight years.

Mr. Thomson is a graduate, in Civil Engineering, of Rensselaer Polytechnic Institute and for a number of years served as chief engineer of the Corrugated Bar Company of Buffalo, New York, and subsequently occupied the same position with the Kalman Steel Company of Chicago, Illinois, following their acquisition of the former company by purchase in 1924. Since December 1933 he has acted as assistant secretary of the Institute.

Continuous Concrete Track Bed at Moderate Cost

Burlington Railroad Embeds Rails in Solid Reinforced Concrete Slab—Ties Completely Eliminated —Construction Procedure and Details of Slab

A SOLID and continuous concrete railway track bed, lightly reinforced, in which railroad ties are completely eliminated and the main rails, guard rails and gauge rods are embedded in the concrete itself, is the unique accomplishment of the Engineering Department of the C. B. & Q. Railroad. A considerable yardage of this type of track bed has been placed—some as long ago as 1930 and some as recent as June of this year—and all the work, whether comprising street crossings or team tracks, has been found completely satisfactory.

The first cost of this type of construction for street crossings is somewhat less the cost of the rail-top type of crossing. What is of even greater importance is that the maintenance cost is estimated to be practically nothing.

Details of Track Slab

The track bed developed is shown in the line drawing, where it is seen to consist of a continuous concrete slab 8 ft. wide and 18 in. deep, reinforced with a light network of ½-in. square steel bars. The bars, as the drawing shows, are spaced 12 in. in each direction, in a plane 3 in. from the bottom of the slab. The transverse reinforcement has every second bar bent up between rails to take the negative bending moment and to provide added resistance to shear. In addition, the upper plane of reinforcement includes straight ½-in. square bars, 4 ft. 9 in. long, placed so as to alternate with the transverse bent-up bars just mentioned.

Wherever parallel track beds are concreted (see Fig. 4 in particular), the practice is to concrete each 8-ft. slab separately, at grades and levels determined by the track requirements. Then the intervening space is concreted to the usual thickness of concrete street pavements. This procedure was adopted for the simple reason that it is relatively easy to fit the concrete to the rails, rather than to attempt to fit the rails to the concrete.

The Construction Procedure

The method of procedure may be seen from a study of the photographic views (Figs. 1, 2, 3 and 4), as well as the line drawing (Fig. 5).

In Fig. 1 the rails, the guard rails, and the gauge rods of one of the tracks are in position, the track being blocked up to the proper grade and alignment. This was done, it will be observed, before even the form work for the concrete track bed was placed.

Fig. 2 shows the next step, with the form work and steel reinforcement placed in conformity with the previous alignment of the rails.

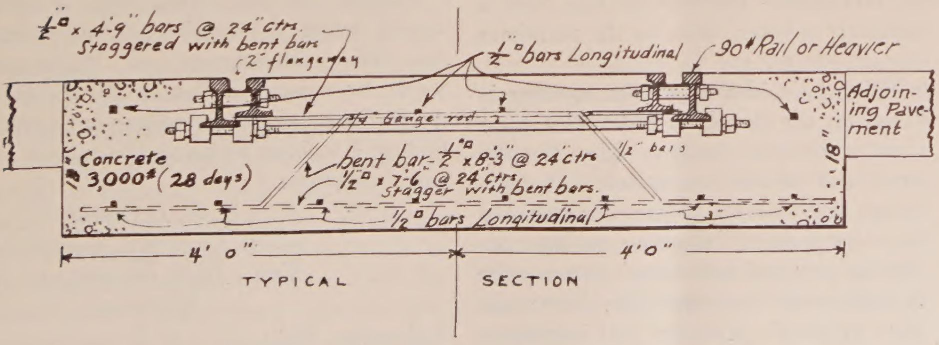

½″□ x 4′-9″ bars @ 24″ ctrs. Staggered with bent bars
2″ flangeway
½″□ bars Longitudinal
90# Rail or Heavier
¾″ Gauge rod
Adjoining Pavement
½″ bars
18″
Concrete 3,000# (28 days)
bent bar-½″□ x 8′-3″ @ 24″ ctrs
½″□ x 7′-6″ @ 24″ ctrs. Stagger with bent bars.
½″□ bars Longitudinal
3″
4′ 0″
4′0″
TYPICAL
SECTION

Fig. 5. Typical transverse cross-section of track bed

In Fig. 3 the placing of the 18-in. concrete slab is in progress, the finished surface of the concrete being screeded off on a level with the top of the rails. At the left, in Fig. 3, another track has been made ready for concreting, with rails, form work and steel reinforcement in place; and at the right, in the same picture, a completed track bed may be seen.

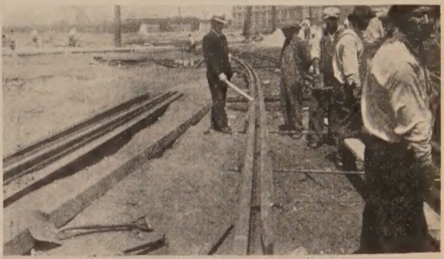
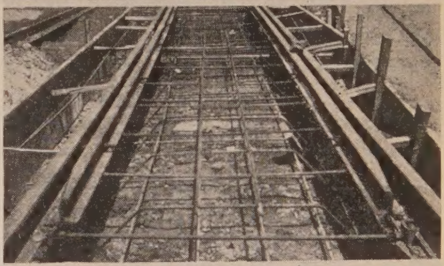
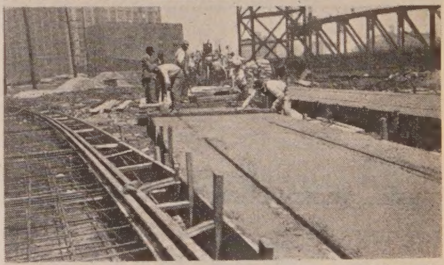
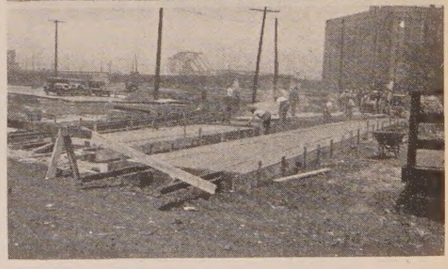





Fig. 1 (Top). Railway crew setting track rails to proper grade and alignment

Fig. 2. Track bed ready to be concreted, with forms and steel reinforcement in place

Fig. 3. Placing the 18-in. concrete track bed

Fig. 4 (Bottom). Parallel track beds were concreted separately, after which intervening space was paved

Fig. 4 emphasizes a point previously mentioned, namely, that the track beds of parallel tracks were concreted separately, after which the intervening spaces were paved. In this view several parallel track beds, the concreting completed, may be seen.

The placing of the main rails and the guard rails was in itself a procedure that required careful planning in advance. First, old rails were placed across the track-bed excavation at short intervals and the main rails were placed upon them. The gauge rods then were attached to the main rails and the gauge was properly adjusted, after which the track was brought to the proper grade and alignment. Then the guard rails were placed by setting them on to the gauge rods, and by means of bolts and pipe separators they were bolted to the heavier rails at a distance such that on straight track a flangeway of 2 in. remained between the heads of the rails.

When the concrete was placed, special attention was given to the part around the rails, where it was carefully puddled to insure complete contact between the concrete and the under-side of the base of the rails. During this puddling process some concrete was worked up between the main rails and their respective guard rails, from below. Whatever space remained between these rails was later filled from above with concrete to within 2½ in. of the top of rails, plus a ½-in. coat of bituminous material, which prevents the entrance of water between rails.

Replacement of Rails

The engineers of the C. B. & Q. Railroad are not in the least worried over the question of rail renewals, even though the rails are partly embedded in concrete. To begin with, they do not contemplate any need for renewal, for many years. In the event that renewals do become necessary, the main rail can be approached by cutting away the concrete along the inner side of the guard rail, removing the nuts on that side and removing the guard rail. Then by cutting away the concrete along the outer side of the main rail, the latter may be removed. After the new rails and guard rails are placed, they can again be fixed into position by placing fresh concrete where the old concrete was cut away.

On some of the work placed in 1930, the outer side of the main rail has become separated from the concrete. To prevent the entry of water, and possible damage to the concrete from frost, this separation has been sealed with a bituminous material.

Acknowledgments. The work shown in the illustrations was placed in June, 1935, under a contract awarded to the Robert R. Anderson Company by the Cook County Highway Department, on plans developed by the Engineering Department of the C. B. & Q. Railroad. J. M. White was engineer-in-charge for the Cook County Highway Department. Development of the track-bed design and the construction procedure was under the direction of F. L. Stone, assistant engineer, C. B. & Q. Railroad. C. L. Persons is assistant chief engineer, and A. W. Newton is chief engineer, of the C. B. & Q. Railroad.

Products Groups in Joint Meeting in Detroit

Cinder Concrete Products Association to Hold Annual Meeting in Detroit and Arrange Joint Sessions with Concrete Masonry Association

MORE good news for concrete products manufacturers comes from the decision of the executive committee of the National Cinder Concrete Products Association to hold its annual convention in Detroit on the same dates (January 21, 22, and 23) previously announced for the annual meeting of the National Concrete Masonry Association.

This important decision was reached by the executive committee of the cinder products group at a meeting held on September 18. The committee decided further to propose a joint program for the two organizations, and it is quite probable that this can be arranged.

A joint program may necessitate several changes in the N. C. M. A. program as announced in the monthly *News Letter* of D. R. Collins in this issue of CONCRETE; but whatever change is made will add just that much more to the interesting things already announced by Mr. Collins.

Regardless of specific details of the joint annual meetings of these two organizations, the fact of greatest importance to products manufacturers is that both groups will meet in the same city on the same dates. This co-operation between the two associations can have but one result—the meeting will have a definitely greater value to the members of each group.

This whole idea of a joint meeting is based on the desire to give convention visitors the best possible value for the time and money expended. Furthermore, the officers of the two associations have started working on the convention program more than four months in advance of the convention dates; and this, in itself, provides full assurance that the program will be complete.

No Slur Was Intended

Editor, CONCRETE: In reading the article in September CONCRETE, headed *Street Car Track Pavement Placed at Low Cost,* I was startled at the following statement at the end of the third column on the first page and at the top of the first column on the fourth page: "This gravel is a mixed material containing some pieces of doubtful quality, and the clay, or silt, content is quite high. The state highway department, however, accepts this material for concrete highway construction." The specifications of the Ohio Department of Highways are in accord with nationally recognized specifications for concrete aggregate and place definite limits on the clay or silt content. All concrete aggregate is required to be clean.

Perhaps no one other than myself would detect a possible inference that the Ohio Department of Highways might be somewhat lax in its requirements for concrete aggregate; but nevertheless I wanted to bring the matter to your attention.

R. R. LITEHISER
Chief Engineer, Bureau of
Tests, Ohio Department of
Highways

Columbus, Ohio
Sept. 24, 1935

How Vibration Improves Highway Concrete

Now Generally Required on Structures—Illinois Experiments Show Value of Vibration in Compacting Pavement Concrete

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The September issue contains an article headed "New Practice in Concrete Highway Joints," taken from a paper by V. L. Glover, engineer of materials, Illinois Division of Highways, presented at the twenty-first annual Road School held at Purdue University, Lafayette, Indiana.

Another section of the same paper contains a discussion of the use of high-frequency vibration in placing concrete in road and street pavements and highway structures. That discussion is given here, in full.—Editor.

PLACING concrete mixtures with vibratory equipment is a comparatively recent development, although the principle is not new. It was tried experimentally on laboratory specimens more than a decade ago. The successful placing of mixtures by vibration under actual construction conditions, however, has depended upon the development of proper equipment with which to perform the operation satisfactorily.

Required on Highway Structures

The compaction of concrete in structures by vibration is at present required in many states; the compaction of pavement concrete by means of finishing machines equipped with vibratory screeds is, so far as known, required in only one state. Illinois requires vibration of concrete in all structures having a span of 20 ft. or more. For smaller structures hand and vibratory methods are optional with the contractor.

One season's construction has been completed under these specifications, and while a complete study has not been made of the data obtained it is felt that vibration is far superior to hand methods in consolidating the concrete. On the other hand, it has become apparent that knowledge of the vibratory equipment employed in this work is inadequate. In case of many of the vibrators it is felt that there may not be sufficient power behind the vibration and that there may be a too pronounced damping of the vibration when the vibrators are inserted into the concrete.

Various suggestions, such as limiting the output of concrete or limiting the size of mixer, have been considered; but it is felt that before such suggestions can be considered seriously some additional information must be obtained. To this end we are procuring vibrating reed tachometers for studying the frequency of vibration obtained with the equipment employed.

Selection of Mixtures

The selection of concrete mixtures for use with the vibratory equipment has been characterized by a certain conservatism. It is quite possible that the full benefit in saving of cement without reduction in quality of concrete has not been realized through the use of the vibratory equipment. It is felt, however, that conservatism is desirable so long as the method of procedure is experimental or semi-experimental, especially since the concrete in test specimens cannot be vibrated in the same manner as that in structures.

On the average, therefore, the weight of sand per bag of cement has been kept about the same and the amount of mixing water about the same, or a little less, than when hand methods are used, whereas the amount of coarse aggregate has been increased to conform with the ability of the equipment to place the mixture. The consistency of the concrete was varied to suit the particular condition, the slump ranging from 1 to 4 in. with an average of 2½ in. Probably the saving in cement did not exceed one-fourth bag per cubic yard of concrete.

Under these conditions it would be expected that the quality of the concrete obtained would be at least as good as that obtained by hand methods. That the consolidation obtained was better could be seen both by observation of the placing of the concrete and from the appearance of the finished product.

Tight Forms Necessary

Tightness of forms is much more important than when hand methods are used. Any opening will cause leakage of mortar from around the coarse aggregate, resulting in a small area of honeycombed concrete at such point. Small air bubbles between the form and the mass of concrete which mar the appearance somewhat seem to be a natural consequence of this method of placing, but these have not presented any particular problem. A large percentage of these may be removed on exposed surfaces by rubbing.

The rapidity with which vibratory methods of placing concrete in structures have been accepted by engineers and contractors alike indicates that the method is not only sound from an engineering standpoint, but that it is equally justifiable from the standpoint of savings in the cost of construction operations.

Courtesy Engineering Extension Department, Purdue University

Placing concrete in a structure by internal vibration

The use of vibratory methods of placing concrete pavements has not received the universal acceptance accorded the internal vibration employed for structures. Since a pavement is relatively thin, internal vibration is rather impracticable, except where it may be used to advantage in consolidating the concrete at localized points, such as expansion and contraction joints, adjacent to the longitudinal joint, and along the forms. The vibratory units are in general placed on top of the screeds, imparting to these the properties of both screeding and vibrating simultaneously.

Courtesy Engineering Extension Department, Purdue University

Vibratory finishing machine used in experimental construction. Note man walking on top of mixture

Vibrating Pavement Concrete

Although development of other types of vibrating units has been reported, the vibration used in placing concrete pavement up to the present time must in general be classed as external vibration, applied to the surface of the mass, and not to its interior.

The advantages which result from external vibration in placing concrete pavement are well known. Since drier consistencies may be used, either the water-cement ratio may be decreased, resulting in higher-strength concrete; or the amounts of aggregate may be increased, resulting in a saving of cement; or a middle course, that of decreasing the water-cement ratio and increasing the amounts of aggregates simultaneously but to lesser degrees, may be followed, resulting in both increased strength and saving of cement. This not only follows from the fundamental principles of design of concrete mixtures, but it has also been shown through investigation performed by three or four states to study the merits of this method.

Illinois undertook an investigation during the month of August, 1932, and included the construction of about one mile of pavement, consisting of 114 individual sections and nearly as many different mixtures, duplications being made in a few instances. Both gravel and crushed stone coarse aggregates were used. The finishing machine was essentially a standard type with the screeds designed in a slightly different manner. Three vibratory units, which operated at about 3,600 impulses per minute, were placed on the front screed and two on the rear screed.

The design of the mixtures was varied to show not only the most suitable proportions but also the limitations of the equipment. The quantities of aggregates per bag of cement were varied approximately from 180 to 265 lb. of sand, from 320 to 510 lb. of crushed stone, and from 360 to 540 lb. of gravel, the larger quantities of sand in general corresponding to the larger quantities of coarse aggregate. The cement content was varied approximately from 1.1 to 1.5 bbl. per cu. yd. of concrete. The amount of mixing water for standard strength was in the vicinity of 5.33 gallons per bag of cement, but had to be increased for several of the harsher mixtures in order to place these satisfactorily.

It was found that standard strength was in general obtained where the mixing water was not increased above the specified amount, and that satisfactory consolidation of the concrete was obtained in all instances. The most suitable mixtures were of about ½-in. slump and contained a ratio of sand to total quantities of aggregates of 32 to 35 per cent. A reduction of about 15 per cent from the amount of cement used with ordinary equipment was obtained without sacrifice in quality of the concrete.

Vibration to Become General

Favorable results have been obtained from similar investigations by others, and while this method of placing concrete pavement has not been widely accepted, that fact can not be attributed to the fact that the benefits which can be derived from it are unknown. It is rather that some uncertainties still exist which warrant further preliminary work, and perhaps also the equipment used may not be considered as fully developed.

With the information already on hand relative to the placing of concrete mixtures by means of vibration capable of being used as a basis for further investigation, it is to be expected that many improvements, both in equipment and methods, will follow shortly. It is probably also safe to predict that vibration will be the chief means of compacting concrete in the near future.

Centrally-Mixed Concrete Patent Agreement

THE Powell Company, of Philadelphia, owner of the Powell Process patents, covering the delivery of centrally-mixed concrete in any type of closed body in which the material is stirred, agitated, or mixed while en route to the point of delivery, has concluded negotiations with the Blaw-Knox Company, Chain Belt Company, The Jaeger Machine Company, and Ransome Concrete Machinery Company, to provide all past and future users of their bodies with full protection under the Powell Process patents. To secure this proper protection it is necessary for future buyers of equipment from these four companies correctly to declare the use to which such bodies will be applied.

Concrete bodies made and sold heretofore and hereafter by any other body-manufacturing companies than the four noted are not protected by the Powell Process patents. Powell Company is willing to consider a settlement at some reasonable rate with operators of such other equipment, where such equipment has been purchased prior to January 1, 1935, and has been or is being used in the dual-mix process—that is, in transporting central-mixed concrete. Such an arrangement may be desirable to owners of this equipment in order that they may obtain full protection for the balance of its life in operating under this method.

✦ EDITORIAL ✦

Concrete Arrives as Architectural Medium

The age in which we live has received various names. It has been called the iron age, the alloy age, the electric age, and the like. Probably the age of imitation would be a better name than any of the others. We all know of the prevalence of imitation. It seems that no new material of construction, no new manufactured item, can be marketed unless there is some imitation of something that has gone before. Steel imitates wood, wood imitates steel, and concrete is used to imitate wood, stone, and a wide variety of clay products.

For many years concrete has been an imitator. Comparatively recently, however, it has been recognized that concrete has characteristics and beauty of its own, that it should be used as an architectural medium, and not to imitate some other material. The next step in concrete's development has come to our attention within the last few weeks. Concrete and stucco are commencing to appear in the role of imitated materials. There are a number of examples of this at the San Diego Exposition. The permanent buildings are portland cement stucco; the temporary buildings are covered with plaster made to imitate stucco so completely that it is difficult to distinguish one material from the other. Then there is a steel building, the outer surface of which is coated with paint to which sand has been added to give the effect of stucco. Finally, there are numerous wooden benches which have been coated with paint and sand to give the effect of the familiar type of concrete bench.

And so, we say that concrete, as an architectural medium, has arrived.

Salvaged with Cement-Bound Macadam

The marvelous come-back of cement-bound macadam nowhere has been more strikingly demonstrated than in its ability to salvage old brick streets.

In Chicago alone, more than 300 miles of bumpy, dangerously potted old brick streets, many of them all but impassable because of lack of repair, are to be salvaged by the cement-bound macadam process under that city's WPA paving program.

The bricks will be taken up and broken by hand. Experience has shown that this method produces fewer small particles—and therefore less waste—than is the case with mechanical crushing.

This work is ideal for the employment of relief labor. While comparatively little machinery is used, the materials used *do* require machinery and skilled labor in their production and transportation.

Attend This Unusual Convention

Home building is leading the construction industry back to recovery; and in home building the concrete products manufacturing industry is finding its biggest market. This has already been reflected in full-time operation of many concrete products plants, and equal activity among the manufacturers of concrete products machinery.

Because of this greatly increased activity, and the unusual program planned for the forthcoming annual convention of the National Concrete Masonry Association, tentatively scheduled to be held in Detroit on January 21, 22 and 23, it is well within reason to predict that the men who attend that convention will go home with more real information than they have ever obtained from any similar gathering of any kind.

It is an unusual program. It is so unusual and it seems so practical that, even at this early date, concrete products men are asking each other why some one had not thought of it before.

Routine convention business, talks and papers, will not even take up all of the first day. On that day the greater part of the afternoon will be given over to a demonstration of painting concrete masonry walls. Manufacturers of concrete paints will demonstrate their products and the methods of application which have proved successful.

The remaining two days will be devoted to bus trips, partly to inspect high-class concrete masonry in some of the principal buildings in the city, but mainly to see demonstrations at some of the best-equipped products manufacturing plants in Detroit, where manufacturers of concrete products machinery will have an opportunity to show their newest and best equipment in actual demonstrations—in the actual process of manufacturing concrete building units and related products.

After all, this is why manufacturers and contractors and architects and engineers attend conventions—to learn about the newest equipment and processes, and the latest improvements to old equipment and processes. In what better way can they gain this information than by seeing the new and improved machines and methods in actual operation at an established manufacturing plant?

There can be no question about the value of such a convention. Not a single products manufacturer in the United States or Canada can afford to stay away.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Standard Housing Units

A COMPREHENSIVE program of standardization in the building industry of Great Britain has been inaugurated through the co-operation of the Building Industries' National Council and the Building Divisional Council of the British Standards Institution. The National Council is a member of the Standards Institution's Council, which includes representatives from all other building interests, such as the Royal Institute of British Architects, the Chartered Surveyors' Institution, the National Federation of Building Trades' Operatives, the National Federation of Building Trades Employers, Building Materials Manufacturers' and Suppliers' Committee.

Building Code Committee Organizes

SIXTEEN national technical associations, construction and fire protection organizations, and governmental agencies, have named representatives to serve on the American Standards Association's building code correlating committee, the appointment of which was mentioned on this page in the July (1935) issue of CONCRETE. The committee met in New York on September 17, to complete its organization. Representatives of several organizations are expected to be appointed.

This committee will appoint several technical committees, which will report on the many problems involved in developing a national building code. This work will serve to guide states, municipalities, and federal departments in writing their own building regulations. Several technical committees are already handling work in the building code field under the auspices of the American Standards Association.

The committee will continue the development of standards applicable to building codes started in 1921 by the Department of Commerce Building Code Committee, discontinued early in 1934 due to reduction in expenditures for the ordinary activity of the Department of Commerce. Industry will accept an increased share of the burden for those projects in which it is vitally interested. The National Bureau of Standards will continue an active interest in the field of building code regulation, and will maintain close co-operation with the committee appointed by the American Standards Association.

Welding Course Offered in Cleveland

BEGINNING August 26, a special five-day course in welding engineering was resumed in Cleveland by the John Huntington Polytechnic Institute in co-operation with the Lincoln Electric Company. The course will be conducted once each month, except during November, through May, 1936. Engineers, welding supervisors and foremen will have an opportunity to engage in intensive study of both the practical and theoretical sides of arc welding. In view of the great interest in past sessions of this course, a full enrollment is anticipated for each of the weekly periods.

The course consists of day and evening sessions. Day sessions are held between 10:30 a.m. and 4:30 p.m. at the plant of the Lincoln Electric Company, which has offered the facilities of its welding school under the direction of A. F. Davis, vice-president. Evening sessions are held at the John Huntington Polytechnic Institute, between 7:30 and 9:30, and are devoted to lectures and discussions.

Changes in Methods of Testing

COMMITTEE E-10 on Standards, of the American Society for Testing Materials, at a meeting held on August 22, accepted minor revisions in the *Tentative Methods of Verification of Testing Machines* clarifying certain sections of the methods. Since criticisms of the *Standard Specifications for Round-Hole Screens for Testing Purposes* (E 17-33) resulted from the fact that there were no tolerances on plate thickness and spacing for openings, the tentative revision which was approved at the August meeting provides such tolerances and also requires triangular spacing. Revisions in the form of proposed new tentative specifications will supersede the existing standard.

Isteg Bars Prove Quality in Floor Tests

DURING the construction of a new building in Sloane St., London England, says the June (1935) issue of *Concrete and Constructional Engineering*, comparative tests were made of floor panels, one of which was reinforced with plain steel bars and the other with *Isteg* bars. These latter bars, described in the May (1934) issue of CONCRETE, page 12, are made by twisting together two mild steel bars to form a rope of two strands, and having a pitch of 10 to 15 times the diameter of the bars used. The type is used almost exclusively for concrete reinforcement throughout Europe.

The tests were conducted by R. H. H. Stanger, and were witnessed by representatives of the London County Council. Each panel measured 13 ft. 5¼ in. by 13 ft. 6 in. in plan, and was constructed as a hollow tile floor with ribs 3 in. wide at 15-in centers. The tiles measured 12 by 12 by 5 in., and the thickness of the concrete above the tiles was 1¼ in. Thus the total depth of the floor construction was 6¼ in.

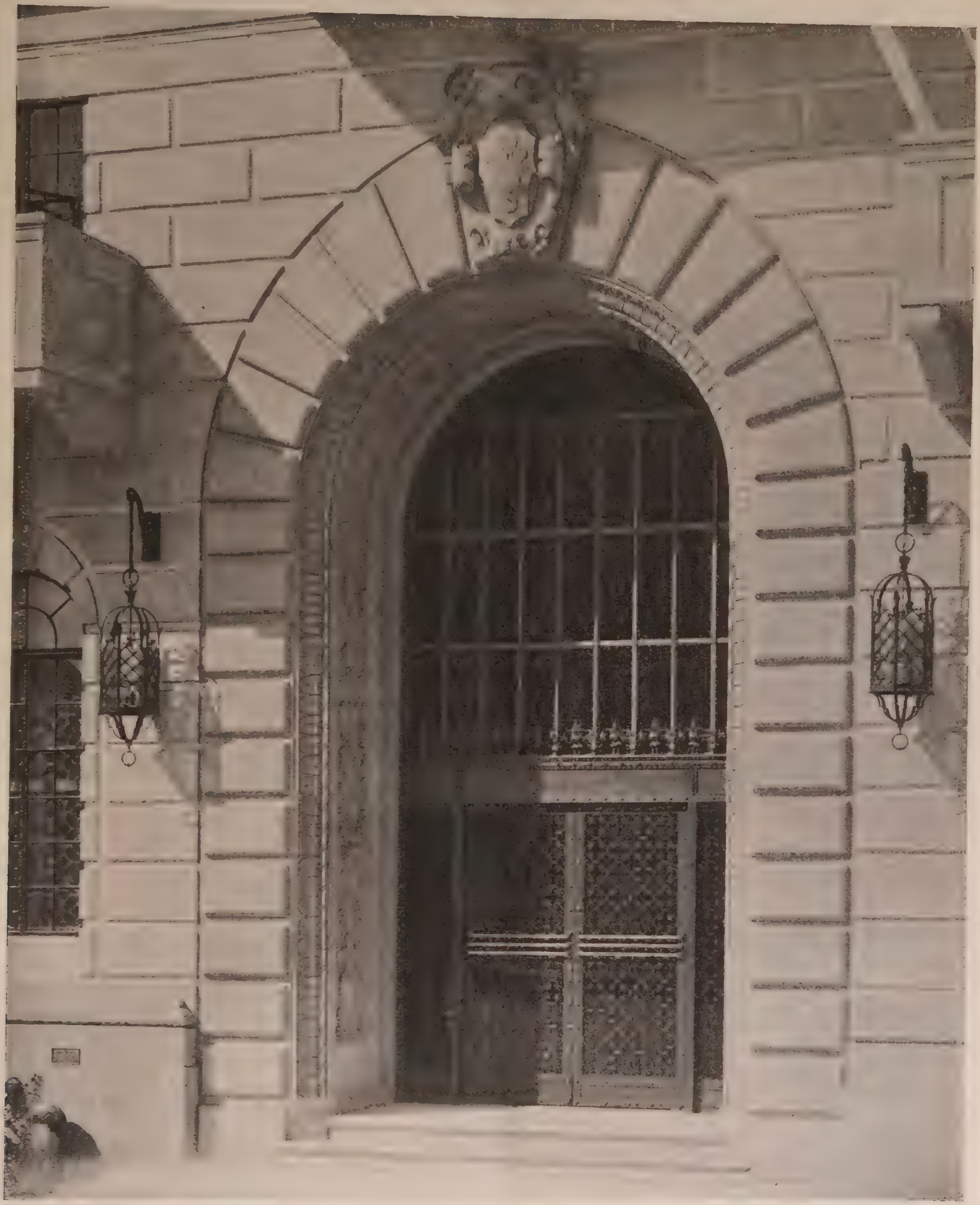
The panel containing plain steel bars had, in each rib, two ⅝-in. bars of mild steel, with a combined cross-sectional area of 0.612 sq. in. The bars had hooked ends, one bar being straight and the other bent up at each end over the supporting steel beams.

In the panel containing *Isteg* bars, each rib was reinforced with two of the double-stranded bars made up of 11/32-in. mild steel bars, the total cross-sectional area of the steel in each rib being 0.37 sq. in.

Test loads were applied which produced a computed stress of 12,050 lb. per sq. in. in the plain bars, and 19,950 lb. per sq. in the *Isteg* bars. Under these loadings the two panels deflected at the center by practically equal amounts, and neither panel suffered any permanent deflection as a result.

Allowable working stresses are 18,000 lb. per sq. in. for the plain bars of mild steel, and 27,000 lb. per sq. in. for the *Isteg* bars, also made of mild steel.

Architectural Concrete



Lee Callahan and Sons, *Architects*

One method of treatment of a monolithic concrete entrance is shown in this close-up view of the entrance to the Langham Apartments, in Los Angeles. The ornamental keystone was cast in a waste mold set in the forms. The rustic effect around the entrance was obtained by nailing small beveled strips to the form work. Lee Callahan and Sons, architects.

Small Dams—
How to Build Them

Details of Masonry, Rock-Fill and Earth-Fill Types—Concrete Work in All Types

IN the September issue of CONCRETE, pages 6 to 8, an illustrated description of small dams of the concrete gravity type sets forth the problems encountered in the preparation of the foundation, the construction of form work, and the construction details of the dam itself, as shown in a printed folder issued by the Portland Cement Association. The present article contains details and descriptions of small dams in which other types of construction are employed, although some concrete work is required in all of these.

It should be remembered that the concrete gravity dam is the safest type, whether the structure is large or small, and that the types described in this issue should be regarded as inferior construction when considered in comparison with all-concrete dams. Nevertheless, conditions will be encountered in which one or another of these types will appear best suited to the case in hand.

Masonry Gravity Dam

In a masonry gravity dam, the joints between all units should be completely filled with cement mortar. Care should be taken to obtain good bond in all directions. It is also important that the masonry be laid in a random manner rather than in definite courses, as the planes between such courses are paths of seepage. Mortar used for the joints should consist of one part of portland cement to not more than three parts of sand by volume. Ten pounds of slaked or hydrated lime may be added for each sack of cement.

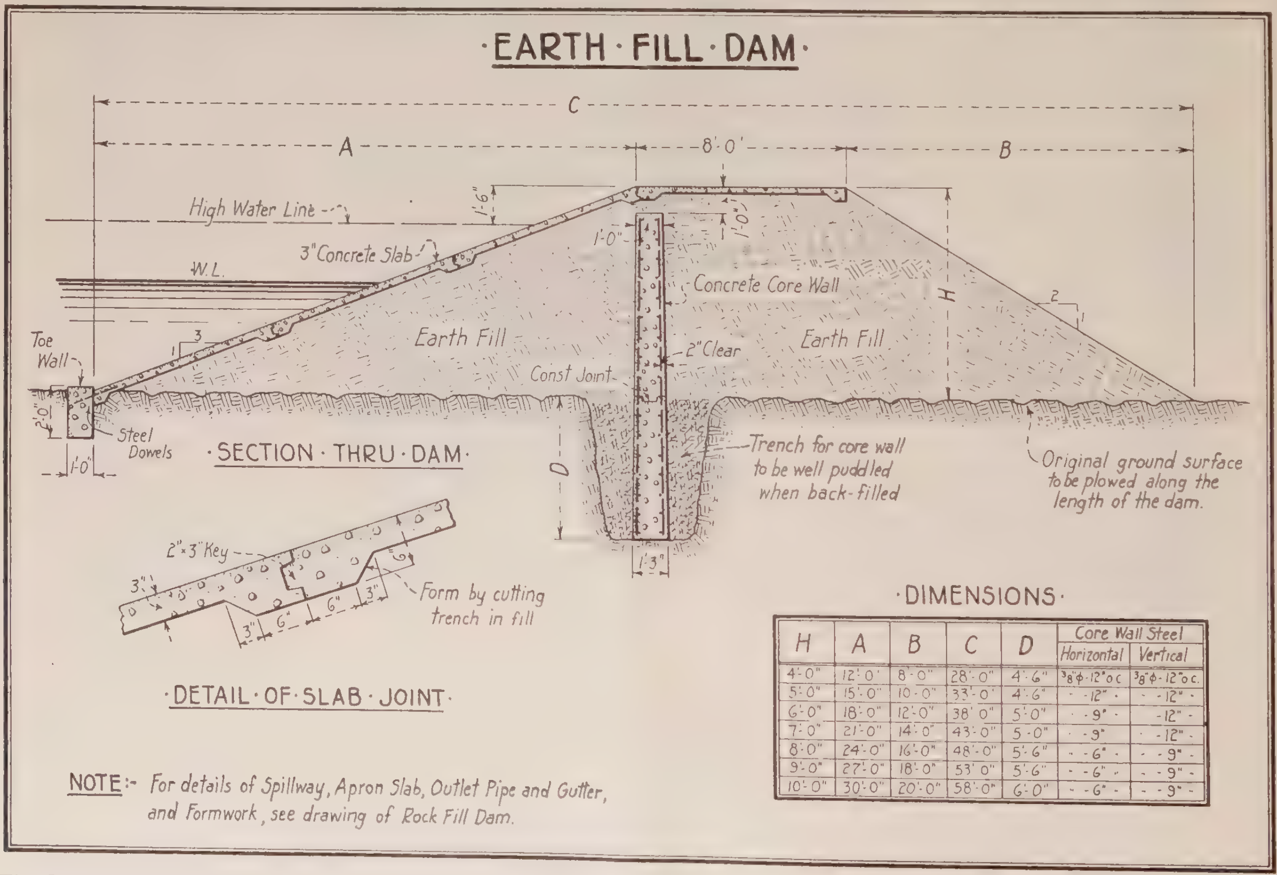
Rock-Fill Dam

All openings between the large stones in the hand-placed rock fill on the upstream face should be filled with portland cement mortar of the same proportions as for masonry gravity dams. A concrete-paved upstream slope and toe wall is necessary with this type of dam. A reinforced concrete core wall is an added safety measure.

Earth-Fill Dam

The filling material should be graded and the least porous material placed in the upstream two-thirds of the structure. The fill on both sides of the core wall must be placed at the same time and should be compacted well against the concrete. If the core wall is made by digging a wide trench and forming the wall down to the bottom of the trench, great care must be taken that the material back-filling the core wall trench is well puddled and compacted. Filling material for the dam proper should be deposited in layers about 9 in. deep. Each layer should be springled and thoroughly compacted over the entire area and should be nearly horizontal, or with the center slightly higher than the sides. Should the work be stopped long enough to allow the surface to dry and harden, this surface should be well plowed and sprinkled before further construction starts.

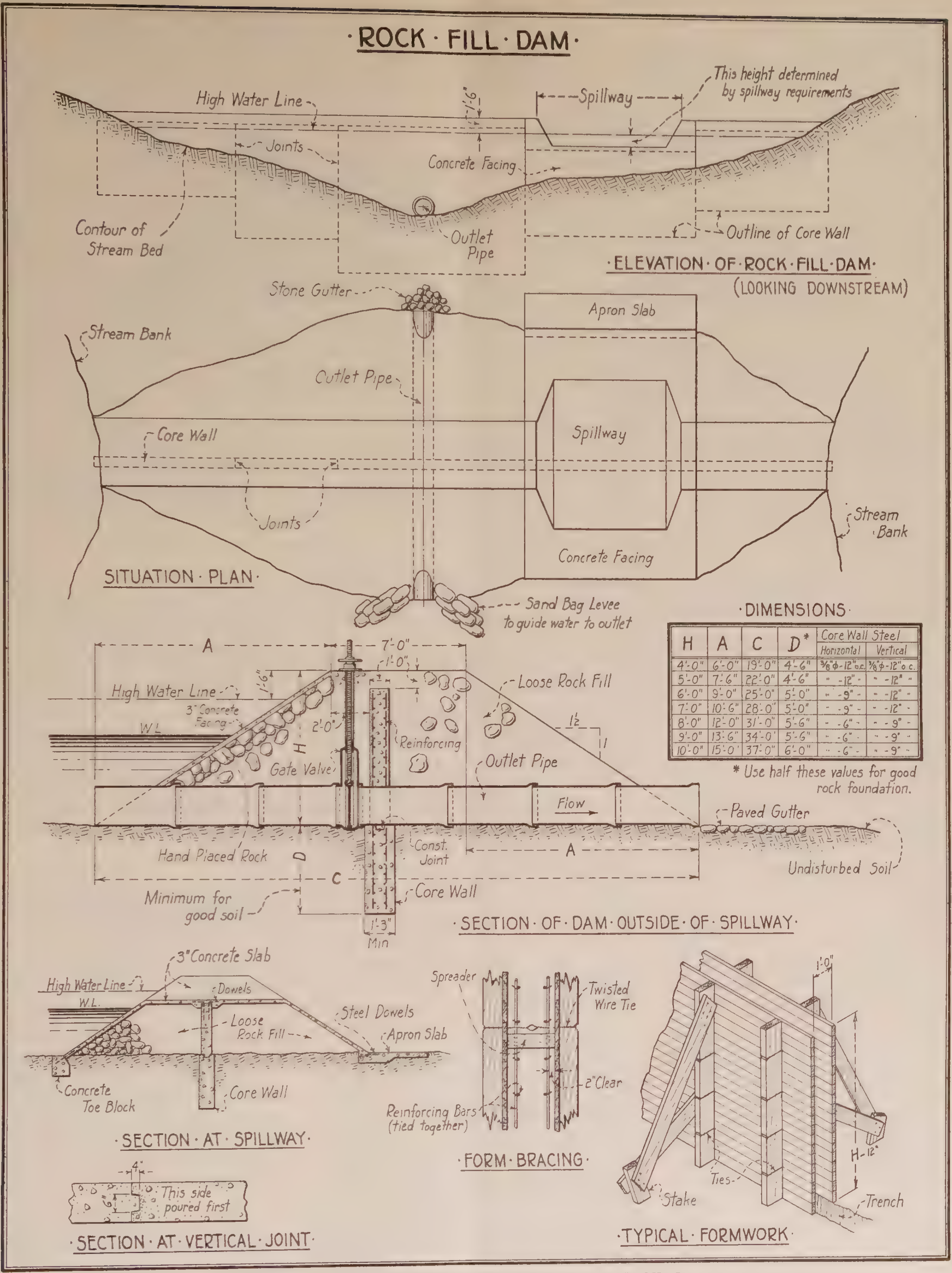
At the ends of the dam the concrete core wall should extend into the banks for at least 5 ft. and the banks should be plowed and sprinkled so as to provide a good bond for the fill material. The con-



H	A	B	C	D	Core Wall Steel	
					Horizontal	Vertical
4'-0"	12'-0"	8'-0"	28'-0"	4'-6"	3/8"φ-12"o.c.	3/8"φ-12"o.c.
5'-0"	15'-0"	10'-0"	33'-0"	4'-6"	" -12" "	" -12" "
6'-0"	18'-0"	12'-0"	38'-0"	5'-0"	" -9" "	" -12" "
7'-0"	21'-0"	14'-0"	43'-0"	5'-0"	" -9" "	" -12" "
8'-0"	24'-0"	16'-0"	48'-0"	5'-6"	" -6" "	" -9" "
9'-0"	27'-0"	18'-0"	53'-0"	5'-6"	" -6" "	" -9" "
10'-0"	30'-0"	20'-0"	58'-0"	6'-0"	" -6" "	" -9" "

NOTE:- For details of Spillway, Apron Slab, Outlet Pipe and Gutter, and Formwork, see drawing of Rock Fill Dam.

Fig. 3—Even with earth-fill dams, much concrete work is required in core walls, spillways, diversion canals, and outlets



·DIMENSIONS·

H	A	C	D*	Core Wall Steel	
				Horizontal	Vertical
4'-0"	6'-0"	19'-0"	4'-6"	⅜"φ-12" o.c.	⅜"φ-12" o.c.
5'-0"	7'-6"	22'-0"	4'-6"	" -12" "	" -12" "
6'-0"	9'-0"	25'-0"	5'-0"	" -9" "	" -12" "
7'-0"	10'-6"	28'-0"	5'-0"	" -9" "	" -12" "
8'-0"	12'-0"	31'-0"	5'-6"	" -6" "	" -9" "
9'-0"	13'-6"	34'-0"	5'-6"	" -6" "	" -9" "
10'-0"	15'-0"	37'-0"	6'-0"	" -6" "	" -9" "

* Use half these values for good rock foundation.

Fig. 4—Construction details of a typical rock-fill dam

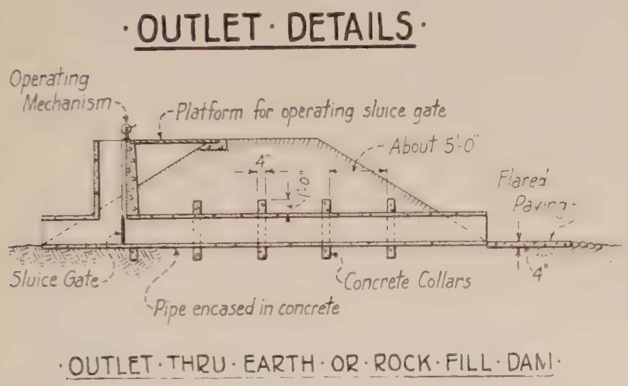
crete protection slab of the upstream face of the dam should extend along the banks of the stream for at least 5 ft. to prevent erosion by wave action. As all newly placed fills settle slightly, it is necessary to build the dam about 10 per cent higher in all places than the height shown on the drawings, to allow for settlement.

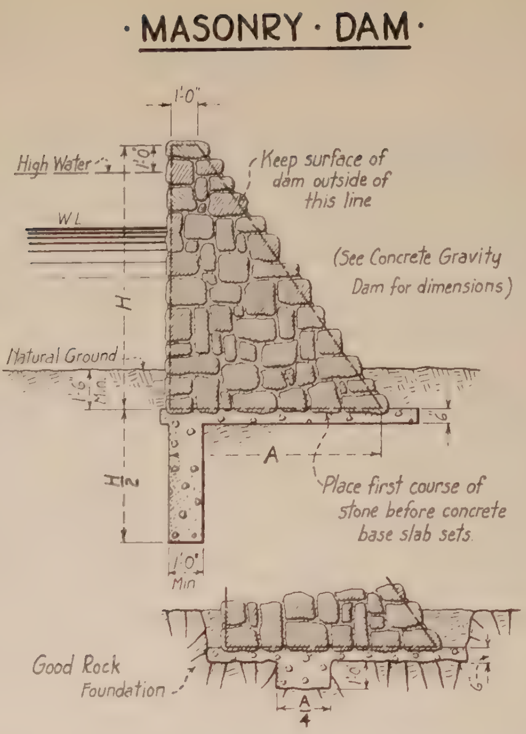
CONCRETE WORK

Use a standard brand of portland cement obtained from a reliable dealer. Protect the cement from moisture until it is to be used.

Sand, gravel or crushed stone should be clean, hard particles, graded in size from fine to coarse. The larger particles should be not more than 1/5 the narrow-

Fig. 5—(Below) Outlet for draining an earth-fill or rock-fill dam. Fig. 6—(Right) Cross-section of small masonry dam on concrete base, and with concrete cut-off wall




·MASONRY·DAM·
1'-0"
High Water
Keep surface of dam outside of this line
W.L.
H
(See Concrete Gravity Dam for dimensions)
Natural Ground
A
Place first course of stone before concrete base slab sets
H/2
1'-0" Min
Good Rock Foundation
A/4

est dimension between forms, and should all pass a 3-in. sieve. It is generally unsatisfactory to use material as it comes from the pit. It should be separated into sand and gravel sizes by screening through a sieve having ¼-in. square meshes and then reproportioned for each batch. Commercial materials which have been washed and screened are recommended.

Steel bars or wire mesh should be used where reinforcement is necessary.

The mixing water should be fit for drinking.

The Mix

All concrete work in or around dams should be built of concrete that will be watertight. Such concrete will also have a very long life, as it will be resistant to the elements.

Satisfactory results should be obtained with a mix of 1 sack cement, 3 cu. ft. of sand, and 4 cu. ft. of coarse material for the dam. To this batch add not more than 5½ gallons of mixing water. For the thinner, reinforced sections of the structure a mix of 1 sack cement, 2½ cu. ft. of sand and 3 cu. ft. of coarse material, with 5½ gallons of added water, should give good results. If the sand is dripping wet, reduce the amount of water to be added. When thoroughly mixed to a uniform color, the concrete should be quite stiff, but plastic enough so that it can be handled and compacted in the forms without allowing the materials to separate or water to come to the top surface. To get good working mixtures, it may be necessary to make slight changes in the proportions of materials given above. Do not, however, increase the amount of water specified.

Placing Concrete

Before placing the concrete, remove all dirt and loose material, such as pieces of wood, from inside the forms. Saturate the forms thoroughly; but when ready to place the concrete there should be no water standing in the forms. The concrete should be placed in layers about 1 ft. thick, each layer being rodded with poles or spades to compact it. When the concrete is made in the correct proportions, water or mortar will not be worked out of the layer during placing.

Construction Joints

Once concreting has been started, it should be continued, if possible, until the section is completed. When it is necessary to stop for several hours or overnight, a construction joint is formed and considerable care is required to make it watertight. When such a joint is to be made, the top surface of the first layer should be swept with a stiff broom just as the concrete is hardening. This will remove the fine materials and any water which has come to the surface, leaving the coarser particles projecting to produce a clean but rough surface. When concreting is resumed, the hardened surface should again be swept clean, then wetted with water and a layer of mortar spread about 1 in. thick just ahead of the new concrete. The mortar should be one part cement and two parts sand, mixed with water to a thick consistency.

Concrete should be kept moist for the first 7 days after placing. The top surface may be covered with wet sand as soon as the concrete has hardened. This should be kept wet by sprinkling. In cold weather the materials should be heated so that the concrete will have a temperature between 70 and 100 deg. F. when placed in the forms, and it should be protected against freezing for at least three days.

Highway Research Board Annual Meeting

THE fifteenth annual meeting of the Highway Research Board of the National Research Council will be held in Washington, D. C., on December 5 and 6, 1935. Further information concerning the program will be published in later issues of CONCRETE. Readers wishing detailed information at this time should write to the Highway Research Board, 2101 Constitution Ave., Washington, D. C.

Leipzig Fair Shows Trade Revival

THE Leipzig Trade Fair, just concluded, indicated a vigorous recovery of business in many fields. The Fair was attended by 125,000 business men from 74 countries, including the United States, and comprised 5,200 exhibits assembled from 22 countries.

The Concrete Products Manufacturer

Association Activities + + + **News of the Industry**

A FEW weeks ago one of the leading manufacturers of concrete products machinery called at the editorial office of CONCRETE. "Things have picked up in fine shape," he said. "In 1933, our lowest year, we employed only three to four men at our plant. Last year we averaged about ten men. This year we have been employing 30 men continually, and they've been kept busy."

What this equipment manufacturer said dove-tails exactly with what "Spec" Collins is saying in his monthly *News Letter* beginning on this page. "That the products industry is decidedly on the up-swing," he says, "is indicated from conversations during the past month with machinery manufacturers who, for the first time in years, are running their plants full time and are behind on repair parts and equipment orders."

The products industry is, in fact, the first branch of the construction industry to feel the thrill of recovery. In view of this happy situation, products men from all corners of the United States and Canada should head for Detroit in January, to attend a most unusual convention of the National Concrete Masonry Association—a convention where new products machinery will be shown in actual factory production, where the painting of concrete masonry will be demonstrated, and concrete masonry buildings of the highest type will be visited.

The convention program appears in Mr. Collins' *News Letter*, and it is discussed elsewhere in this issue of CONCRETE. All those who read the program will be convinced that they can't afford to stay away from it.

Concrete Masonry Industry + News Letter +

Products Industry in Up-Swing—Believes More Constructive Housing Legislation Coming—an Unusual Convention Program for Detroit Meeting

By D. R. COLLINS

Assistant Secretary, National Concrete Masonry Association,
33 W. Grand Ave., Chicago

RESIDENTIAL building, a major market for concrete products, continues its steady march toward recovery. Not only is this reflected in building statistics, but in reports that I have received during the past month from concrete products manufacturers located in many widely separated points in the United States.

Housing Legislation Coming

Word from Washington regarding housing continues to be encouraging. Its spectacular come-back is receiving much attention on the part of officials, and several observers close to the administration state that housing and housing legislation will be the next major moves on the part of the New Deal. Recent legislation continues to point that way. The recent Eccles banking bill provides that "any sound asset of a commercial bank should be eligible for rediscounting with Reserve Banks." This, in effect, puts the reserve banks into the mortgage banking business and provides twelve new sources of liquidity in the home mortgage market. It is a certainty that FHA insured mortgages are going to be highly favored by these institutions.

Secretary Morgenthau, of the Treasury, has become keenly interested in housing, and has drafted Peter Grimm, a prominent New York realtor, to help him. Mr. Grimm is at the present time at work on a plan to co-ordinate the various governmental agencies having to do with housing. In the short time he has been in Washington, Mr. Grimm has accomplished many things and has demonstrated his open-mindedness by asking the aid of industries in the many developments which he is following. The present signs point definitely to aid for private enterprises. It is not at all improbable that at the next session of Congress, legislation will be introduced to provide direct subsidy to approved builders—in all probability in the form of interest grants.

Products Industry in Up-Swing

That the products business is decidedly on the up-swing is indicated by conversations during the past month with machinery manufacturers who, for the first time in years, are running their plants full time and are behind on repair parts and equipment orders.

Products manufacturers, notably those making light-weight units, are constantly increasing the radius of their activities. A few years ago the products business was considered a strictly local one, and it is doubtful that 50 products manufacturers in the country were shipping their products further than within a radius of 50 miles from the plant in which they were produced. Numerous manufacturers, through aggressive selling, have gradually widened this radius so that it is not unusual today to find manufacturers shipping 100 to 150 miles. There is one noticeable thing about all of these manufacturers—they have aggressive sales organizations which are constantly combing the territory and which are responsible for these distant orders adding considerable volume to their business.

Next Convention in Detroit

During the last month, officers of the Association have been negotiating plans for the 1936 convention. If these plans go through, and it looks at the present writing as if nothing could stop them, the 1936 convention of the N. C. M. A. will go down in history as being something decidedly different and worthwhile.

The officers have had the feeling that with housing the major market ahead, most manufacturers are interested in how units that go into houses are made —especially ashlar units. It has been quite surprising to observe the number of manufacturers who have written to Association headquarters to inquire just what new equipment they would have to buy to make concrete ashlar. By far the majority of these manufacturers have already had the equipment in their plant, but have not known how to use it.

Probably no section of the United States has as many good-looking ashlar buildings of all types as Detroit. For this reason, the directors have selected Detroit as the 1936 meeting place, and have tentatively set the dates as January 21, 22 and 23.

Demonstrations at Plants

The convention will be different because only a small part of it will be held in the hotel which has been selected—the Statler. The balance of the program will be held in concrete products plants in and around Detroit, and in the various buildings built of concrete masonry in the Detroit area. In other words, there will be very little speaking; but manufacturers will be allowed to see for themselves how products of various kinds are made on various types of equipment—will be given visual demonstrations of the erection of ashlar walls—of both interior and exterior painting and waterproofing, and then will be given an opportunity to see many of the structures which they have read about and of which they have seen pictures in the various magazines.

Detroit an Inspiration

Detroit offers unusual advantages in this respect. There are being erected at the present time, houses in the $5,000 class that probably surpass anything in this price range in the United States for utility and beauty. And going up the ladder it is possible to see homes in every cost classification from the price named above, up to $85,000.

Then too, Detroit has many theaters, offices, libraries, schools, and other public buildings, in which concrete masonry has been used. It is probably the source of more inspiration, and has been responsible for more creditable sales in the introduction of concrete masonry on major jobs, than any other city in the United States.

CONVENTION PROGRAM

The following tentative program has been outlined:

January 21 Morning—Registration.
Business Meeting.

January 21 Afternoon—Short talks by two prominent architects who have made extensive use of concrete masonry in major construction jobs.
A talk by an operative builder who has made a notable success of concrete masonry houses in the low-cost field.
Demonstration of painting and waterproofing concrete masonry walls, both interior and exterior.

January 22 Morning—Buses to leave hotel at 9:30, taking party to plant of Cinder Units, Inc., where demonstration of making various sizes of ashlar units will be held on Besser, Anchor and Multiplex machines.
Visit to plant of Standard Building Products, where demonstration will be made on two new machines being developed by Stearns Manufacturing Co. (Eugene Olsen).
It is possible that other machinery manufacturers will have demonstrations as well.

January 22 Luncheon—At one of the YMCA's on the West Side where concrete ashlar has been used.

January 22 Afternoon—Demonstration of manufacture of joists at plant of Hay-Con Tile Co. Balance of afternoon to be spent visiting several notable jobs—houses, theaters, perhaps the Ford Courtesy Building, in which 150,000 concrete masonry units have been used.

January 22 Evening—Annual banquet and entertainment sponsored by machinery manufacturers.
It is expected that the annual banquet will be reminiscent of the banquets held prior to 1929, and already negotiations are under way to provide elaborate entertainment.

January 23—An all-day trip, leaving the hotel at 10 o'clock, bus visiting many outstanding concrete masonry and ashlar jobs in and around Detroit.

Every products manufacturer ought to plan on attending this Detroit meeting. It is not too soon to start those plans in putting away a little convention fund. I feel certain that attendance at this meeting will make every manufacturer have more enthusiasm and respect for the business in which he is engaged than he has ever had before. It will be a real business investment.

News of the Products Industry

Deny Permission to Remove Sand

The Lake Shore Cement Products Company, Kenosha, Wis., has been denied permission by the State Public Service Commission to remove 15 cubic yards of sand and gravel daily from the lake shore in the town of Somers, just north of the Kenosha city limits.

The denial of the application of the cement products firm was handed down by the commission after investigation had revealed that the removal of sand and gravel washed up on the beach had made the adjoining property less desirable as a bathing beach.

Unearth Ancient Cement Slabs

Stone-like slabs, which seemed to indicate prehistoric peoples possessed the knowledge of making cement, were found under several feet of volcanic ash in an earth-mound near Challis, Ind., recently, says The Associated Press. The materials, unearthed by B. S. Brown and a party who were searching for rock crystals, were piled in a systematic manner similar to that used by lumber yards. The individual slabs resembled sawn lumber, even to the graining of the boards, and were of unusual composition.—*New York Times*, July 3, 1935.

Fireproof Construction

THE investment value of fireproof construction in industrial plants was again proved last month when thick masonry walls, cement-asbestos roofs and heavy steel doors were given credit for having helped save the Hiram Walker distillery at Peoria, Ill., from complete ruin when flames destroyed a large rackhouse and threatened the entire group of structures.

New Concrete Pipe Co.

The Union Concrete Pipe Co., Inc., Parker, Washington, has been incorporated with $50,000 capital stock to deal in cement and concrete products. Incorporators are Stella Ban, Frank H. and Glessner C. Souther.

WELDING CONCRETE

Employ Newly Developed Equipment to Shoot Dense Surface on Honeycombed Concrete

By A. T. CASSIERE
Los Angeles, Calif.

ALL members of the construction industry will admit that the unusual problems encountered on a project are the ones that determine the degree of alertness and efficiency possessed by the construction superintendent in charge.

Surface Badly Honeycombed

When placing the concrete in a new building in Los Angeles recently, every reasonable precaution had been taken to obtain good work. But when the forms were removed, a considerable amount of honeycombing was found. The problem in hand clearly was one that required something more than mere patching.

Fortunately for all concerned, the architect was also a practical builder. He would tolerate no patching of the walls. Neither would he demand that they be torn down if properly repaired. The local building inspector maintained the same attitude as the architect, and further insisted upon tangible proof that whatever was done must meet the original requirements of the building inspection department at the time the building permit was applied for.

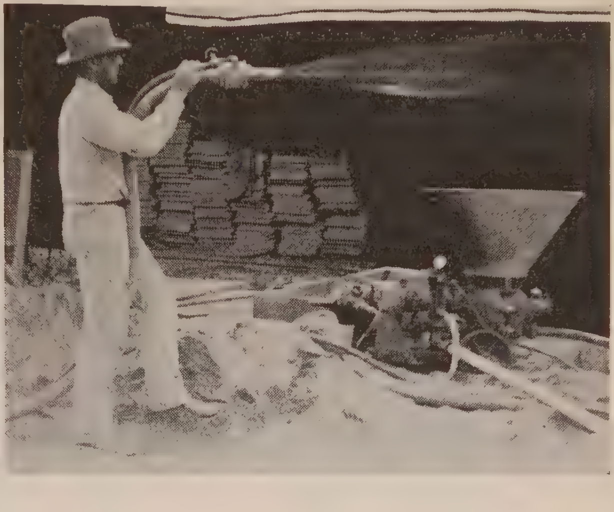
Prepare Surface for Gun Work

Within a few days after stripping the forms and exposing the honeycombing, there appeared on the site a portable compressor for "shooting" concrete.

The operating crew, while waiting for the sand and cement to be delivered, chipped away all loose and unbonded portions of the concrete aggregate, so as to expose a firm and clean surface to shoot against. This work was done with pneumatic chipping hammers and prospector's hand picks.

After the chipping and cleaning had been completed, and before the shooting commenced, tests were made of the concrete in the standing walls, and it was found to be very satisfactory. The loose pockets and streaks proved to be unbonded rock pockets, deficient in cement and sand at these specific points only.

The entire building was then washed down thoroughly with air-steam, an effective scouring agent consisting of a combination of water and air under pressure, and the work was then shot or "welded" with gun work. This gun work, as the trade name—not trade marked—of pneumatically-placed concrete when hydrated in transit, is thus distinguished from "wet concrete" placed under air pressure.


Pneumatic concrete gun repairing honeycombed surface of new concrete building in Los Angeles

Pneumatic Placer Repairs Defects

The placer used on this work is a recent addition to the family of modern construction equipment; and on account of its small compact size and its moderate price it is greatly enlarging the field for cement and gun work. There are no compartments, no levers, no valves to operate in the new placer, and one experienced man is all that is required to handle the entire outfit—namely, the nozzleman.

The technical results of the welding operations on this building were readily ascertained by making cylinder tests of the gun work as the walls were shot, and by making bond tests to disclose the amount of bond or adhesion of the gun work to the original concrete work. In every test it was shown conclusively that the gun work was much stronger, and the bond 100 per cent, when compared with the concrete walls being welded.

The use of this small and compact equipment is being justified by the small contractor in both the plastering and the concrete fields. The larger contractors can profitably maintain this equipment for such emergencies as the one described in this article.

Acknowledgment: The equipment here described is known as the *New Spherical Pneucrete Placer*, put on the market by the Pneucrete Equipment Company, Chamber of Commerce Building, Los Angeles, Calif.

Mineral Aggregates Institute

THE three national associations concerned with concrete aggregates—the National Sand and Gravel Association, the National Crushed Stone Association, and the National Slag Association—have organized the Mineral Aggregates Institute, with headquarters in the Munsey Building, Washington, D. C., each association having two members on the governing board of the Institute.

In behalf of the three controlling associations, the new organization will take over all activities pertaining to public relations, accident prevention, standards of business practice, and kindred matters. This will enable the three aggregates associations to devote their own time exclusively to technical problems.

How This Man Sells
Concrete Septic Tanks

Builds Up Market for Special Products to Take Up Slack in Building Units—Plant Kept Busy

By CALVIN S. GODDARD
Field Engineer, Portland Cement Association, New York, N. Y.

ALTHOUGH early in 1930, the sales of concrete masonry units were apparently taking a nose dive for depths unknown, Ervin S. Williams, products manufacturer of Chelmsford, Mass., sought ways and means of improving his dwindling income instead of liquidating his business and retiring into obscurity.

Selling Methods of 1935

He decided to add a line of precast concrete septic tanks, both cylindrical and rectangular, which he installs and connects before he considers the sale completed. Fair dealing, a good product at a fair price, and no bills rendered until the customer expresses complete satisfaction, build that confidence and good will which Mr. Williams claims as his principal asset.

In the illustration you see him exhibiting a concrete model of his septic tank, built one-twelfth full size, which fits a carrying case of polished hardwood. He uses the model to explain the good points of his tank, finding it easy to sell the home owner by this method. Several part-time salesmen were provided with these models in 1934, one such salesman being the village plumber. Sales of septic tanks in Chelmsford and vicinity show an annual increase in number, due chiefly to these aggressive selling methods. Thirty-five were sold in 1933, 47 in 1934. Sales this year number 35 in the first 7 months, with expectations of a grand total of about 60.

Public Displays That Help

Being a man of inventive genius, Mr. Williams has devoted many hours and much thought to the improvement of his concrete septic tank. He has succeeded in creating a superior product, flexible as to size and capacity, overcoming previous defects, and assisting materially in developing satisfaction and good will of the type that makes more sales and builds bigger business.

It is planned to mount on a suitable platform along a main highway, a full-sized septic tank, together with a suitable billboard on which will appear the firm name and address of the plant. One such installation is already on display at Bedford, Mass., at the business location of a regularly appointed William's agent. Several new customers having been secured by this plan, Mr. Williams is now about to set up similar displays at Ayer and Lowell, nearby cities.

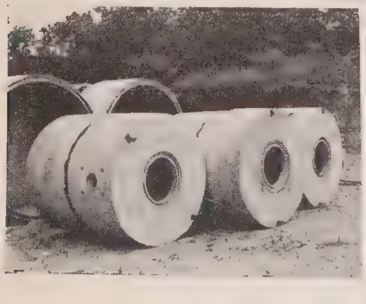
Not Neglecting Other Products

Mr. Williams is not neglecting the concrete block business. He has a neatly piled storage yard, equipped with a spray system for easy water curing. Several blocks in each pile are plainly marked with the selling price, a practice which builds customer confidence.

A circular well curbing, built in 4-ft. lengths, 4 ft. in diameter, is another product of this yard that has exceptional merit. Fitting together by tongue and groove, these rings are superimposed one on another and allowed to settle into the well hole as excavation proceeds. From three to eight sections are required to line a well, and about twenty sections are sold monthly, on the average.

As evidence that a failing business can be revived and turned into a profitable and worth-while industry by energetic initiative, improved ideas and creative genius, Mr. Williams states without reservation, that 1935 will be his best year so far. How much better, he does not care to say, declaring he is "too busy to do any figuring." It is, however, a matter of record that five cars of cement were used at this small but hustling plant in the first seven months of this year.

At right: Ervin S. Williams with small model of concrete septic tank that pulled him through the depression. Below: Full-sized product



Below: Concrete building blocks have not been neglected. A neatly piled storage yard is a valuable asset as a sales aid

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Coming Conventions

Oct. 7-10—**American Public Health Association. Annual. Milwaukee, Wis.**

Oct. 14-16—**Public Works Engineering Conference. Joint Meeting of the American Society of Municipal Engineers and International Association of Public Works Officials, Cincinnati, Ohio.**

Oct. 14-18—**National Safety Council. 24th Annual Safety Congress. Louisville, Kentucky. A. J. R. Curtis, 33 West Grand Avenue, Chicago, Secretary Cement Section.**

Oct. 16-18—**American Society of Civil Engineers. Fall Meeting. Birmingham, Ala.**

Oct. 23-25—**National Council of State Boards of Engineering Examiners. Annual. Columbus, Ohio.**

Oct. 23-25—**National Society of Professional Engineers. First Annual. Columbus, Ohio.**

Dec. 2-7—**Chemical Industries. 15th Exposition. Charles F. Roth, The International Exposition Co., Grand Central Palace, New York City.**

Dec. 5-6—**National Research Council Highway Research Board. 15th Annual. Roy W. Crum, Director, 2101 Constitution Ave., Washington, D. C.**

Dec. 9-12—**American Association of State Highway Officials. Annual. Miami, Fla. W. C. Markham, Exec. Sec., 1222 National Press Bldg., Washington, D. C.**

Jan. 20-24—**American Road Builders' Assn. Annual and Road Show. Cleveland Exhibition Hall. Chas. Upham, Engineer-Director, National Press Building, Washington, D. C.**

Jan. 21-23—**National Concrete Masonry Assn. Convention. Statler Hotel. Detroit. Horace W. Bush, Secretary and Treasurer, 211 Edgewater Place, Teaneck, N. J. D. R. Collins, Asst. Secretary, 33 W. Grand Ave., Chicago, Ill.**

Jan. 21-23—**National Cinder Concrete Products Association. Annual. Detroit. Harry H. Longenecker, Secy., 1600 Arch Philadelphia, Pa.**

LOCAL DUNBRIK MANUFACTURER GETS THE BEST JOBS IN KALAMAZOO

Val Berry, the authorized DUNBRIK manufacturer in Kalamazoo territory, gets all this desirable business *because his product and price are beyond the reach of competition.*

Val Berry's sales are easy because of the high quality of his product—absolute uniformity—square true edges—water repellent faces and strength greater than any building requirement. In addition to common brick, he supplies face brick and DUNSTONE (3 sizes), all in 40 colors, shades and textures, enabling him to supply complete masonry material market.

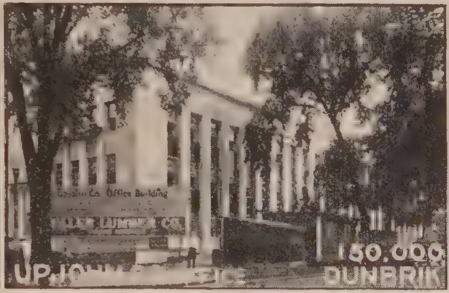
With DUNBRIK design he saves 20% in material—makes a one-fifth lighter brick—thus effecting a saving in hauling, handling and laying. In addition he delivers direct from factory to job, eliminating high transportation costs.

On top of all these advantages, Val Berry's labor cost is less than $1.25 per thousand. The automatic line production DUNBRIK machine not only eliminates every chance of human error but enables a few men to do the work of a large force and at a fraction of the investment.

THEIR BUSINESS FUTURE ASSURED—From Spokane to Newport News—From St. Petersburg to Montreal, wherever located—Authorized DUNBRIK manufacturers are getting as high as 80% of the good jobs.

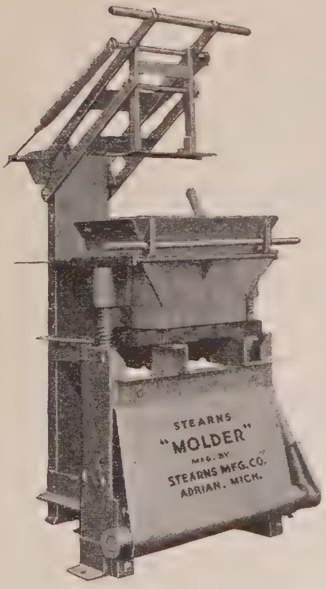
YOUR BUSINESS OPPORTUNITY—Why not learn how you too can become the exclusive DUNBRIK manufacturer in your territory. Write today for booklet "4 Keys to Success."

W. E. DUNN MANUFACTURING CO.
453 WEST 24th STREET HOLLAND, MICHIGAN



—for making

MANHOLE BLOCKS



The "Stearns Molder" turns out cone or batter blocks for manholes fast and economically—dense as power-tamped units. The springs that lift the tamper bars **add** force to the tamping stroke, instead of retarding it.

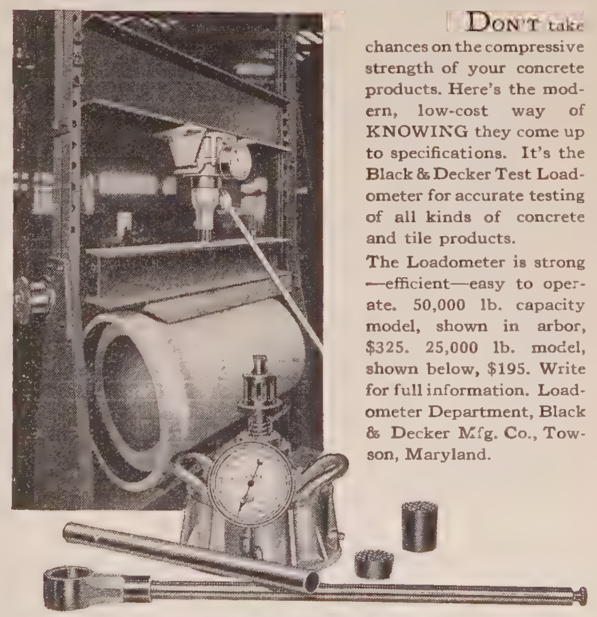
It's a vertical strip machine, with cast mold boxes to insure trueness to shape and size. Mold boxes available for production also of standard manhole barrel blocks, building brick, double brick, header brick, coal briquettes, conduit separators, curb markers, etc. All on plain pallets, wood or steel.

Write for descriptive circular

Stearns Mfg. Co.
Adrian Michigan
EUGENE F. OLSEN, Gen. Mgr.

Repair parts for Anchor, Hobbs, Ideal and Universal machines

Accurate, Low-Cost TEST FOR CONCRETE and Tile Products



DON'T take chances on the compressive strength of your concrete products. Here's the modern, low-cost way of KNOWING they come up to specifications. It's the Black & Decker Test Loadometer for accurate testing of all kinds of concrete and tile products.

The Loadometer is strong—efficient—easy to operate. 50,000 lb. capacity model, shown in arbor, $325. 25,000 lb. model, shown below, $195. Write for full information. Loadometer Department, Black & Decker Mfg. Co., Towson, Maryland.

BLACK & DECKER

HOW TO DO IT

✦ Questions and Answers ✦
Consultation and Comment

A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

Protecting Concrete Against Action of Acids

What have you available on the protection of concrete in tanks designed to contain industrial acids?—J. W. E., Ohio.

An article on page 18 of the January (1935) issue of CONCRETE gives detailed information on this subject. The data given includes the effect of various acids, oils, and salts, and the recommended protective treatment, where protection is required.

Further information is given in a shorter article on page 32 of the February (1932) issue of CONCRETE.

Reference is also made to the protection of concrete from acids in an excellent book which recently came from the press under the title of *Chemistry of Cement and Concrete*, by F. M. Lea and C. H. Desch. A brief review of this book will be found on page 28 of the August (1935) issue of CONCRETE. It is without question one of the best books we have seen on that important subject.

Another good book is one by Dr. Maximilian Toch, of Toch Brothers, New York City, published under the title *The Protection and Decoration of Concrete.* One chapter is devoted to the protection of concrete in chemical works. Both books are for sale by the Book Department of CONCRETE.

Overcoming Reverberation

I have in hand, for correction, a case where the reverberations from the ceilings in a reinforced concrete industrial building, are causing annoyance. The floors are of flat-slab reinforced concrete construction, the concrete having been made of sand and gravel and ordinary portland cement. Can you suggest a remedy?—D. A. C., New York.

In a case very similar to yours, the trouble was overcome in a very efficient manner by means of cement asbestos pans manufactured by the Johns-Manville Corporation. These pans are sprung on to the sleepers, the sleepers being first nailed to the ceiling. Grooves in the sides of the sleepers hold the pans in place after they are sprung into position. This floor was built of stone concrete.

The treatment just described has proved very efficient, although in other cases satisfactory results have been obtained by various types of plastic materials, either sprayed or plastered on to the face of walls and ceilings.

Trouble of this kind may be avoided, if anticipated in time, by using sound-deadening concrete aggregates such as haydite or processed slag.

Molds for Hollow Walls of Concrete

Please give me the names of manufacturers of sliding form equipment for the construction of hollow monolithic concrete walls of the Van Guilder type. What is the situation with respect to patents on these molds?—P. M., Texas.

The two leading companies among those who were engaged in the manufacture of molds of this type some 10 or 15 years ago are not now in business. It is possible that the printing of this inquiry may bring a reply from some equipment manufacturer who is in a position to make such molds.

We can not give you a definite answer on the question of patents—as to whether or not they have expired. You should address the U. S. Patent Office, Washington, D. C., on this point.

Fire Insurance Rates

Where can I get information on fire insurance rates on a business building having outside walls of concrete block and cement stucco?—H. P., Louisiana.

You should write to the Louisiana Rating and Fire Prevention Bureau, Queen and Crescent Building, New Orleans, La. This bureau has jurisdiction of fire insurance rate-making for the state of Louisiana.

Design of Curved Beams

We have a request for a magazine article on the design of horizontally curved beams of reinforced concrete. Can you supply us with any references to such articles?—H. M. S., Illinois.

An article by R. P. V. Marquardsen, headed *Compares Curved and Straight Beams of Rectangular Cross-Section*, appears in the April (1935) issue of CONCRETE. In this article the author discusses the mathematics of the subject and derives certain formulas.

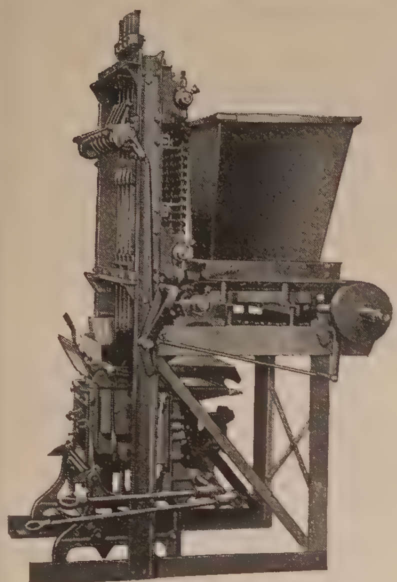
Why Is White Cement White?

Considered from the standpoint of chemical analysis, what is the difference between white and gray portland cement? In other words, what makes white portland cement white?—A. C. P., Ohio.

The first column of the tabulation here given shows the chemical analysis of an average gray (or ordinary) portland cement, while the second and third columns show the analyses of two white portland cements manufactured in the United States.

	Gray portland cement, per cent	White portland cement, per cent	
		No. 1	No. 2
Lime (CaO)	62.0	64.12	61.87
Silica (SiO_2)	22.0	23.56	24.66
Alumina (Al_2O_3)	7.5	5.66	5.60
Iron oxide (Fe_2O_3)	2.5	0.32	0.38
Magnesia (MgO)	2.5	1.54	0.90
Sulfur trioxide (SO_3)	1.5	1.50	1.51
Loss on ignition	1.4	2.92	3.84

It will be seen from the foregoing that, so far as the chemical analysis is concerned, the only marked difference between white portland cement and standard gray portland cement lies in the quantity of iron oxide. The white cement contains (relatively) a very small amount of iron oxide; and because of this absence of iron oxide its color is white. Conversely, the color of gray portland cement is due to the larger quantity of iron oxide contained in it. If it were possible to manufacture a portland cement containing no iron whatever, it would be pure white.



Miles Concrete Equipment

1935 Equipment for 1935 Budgets and 1935 Production Demands

•

The 1935 models of Miles Concrete Products Plant Equipment are fast producers of high quality concrete products.

It pays to be Miles equipped. Prove this to your own satisfaction by investigation.

Write for Catalog

THE MILES MANUFACTURING CO.
Jackson, Michigan

Look for These Trade Marks

STAR COLORS GEO. S. MEPHAM & CO. EAST ST. LOUIS

C. K. WILLIAMS & CO. ANCHOR BRAND MORTAR COLORS CEMENT COLORS EASTON, PA.

Success With Cement Colors Is Mostly in the Choosing

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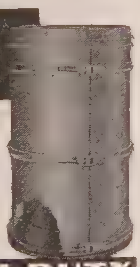

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Reinforced Concrete Houses

REINFORCED CONCRETE HOUSES—CONSTRUCTION DETAILS. Published by the Portland Cement Association, 33 W. Grand Ave., Chicago, Ill. Paper cover, 40 pages, 8½ by 11 in., illustrated. Single copies free.

As the title of this book indicates, it consists mainly of full-page line drawings giving construction details of reinforced concrete walls, form work details, floor reinforcement, window details, reinforced concrete stairs, flat roofs and parapets, construction accessories, and quantities of material. Every architect and every house-building contractor should have a copy.

Fireproof Houses

The LURIE STEEL HOUSE, published by the Metal Lath Manufacturers' Association, 208 So. La Salle St., Chicago, Ill., is a new 16-page book, 8½ by 11-in. page size, containing complete details of construction of the type described and illustrated in an article in CONCRETE, August, 1935, pages 5 to 7.

In this type of construction all steel work is embedded in portland cement stucco or cement plaster. The book contains a number of drawings and details, and should be in the hands of all architects and builders interested in low-cost fireproof construction for homes.

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A SELECTED BIBLIOGRAPHY ON HOUSING is the title of a 16-page pamphlet published by the National Association of Housing Officials, 850 East 58th St., Chicago, Ill. The pamphlet contains a number of references to books, special reports, and magazine articles on various phases of housing, including planning, design and construction.

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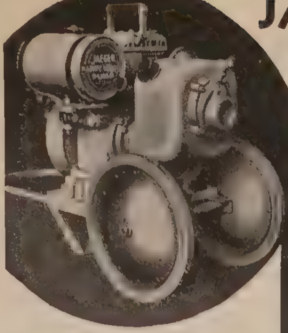
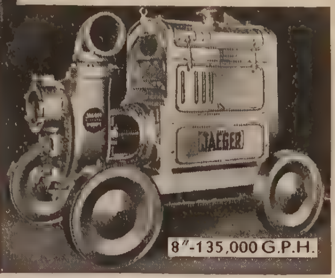

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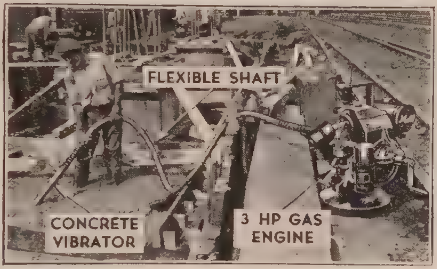

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CHEMISTRY OF CEMENT and CONCRETE

BY
F. M. LEA—Building Research Station, England
AND
C. H. DESCH—National Physical Laboratory, England

This book is intended not only for the chemist, but also for the engineer and architect who deal with cement and concrete.

The following is taken from a review of this book by Dr. LOUIS A. DAHL, Research Chemist, Portland Cement Association

Besides the chapters pertaining to raw materials, phase relations, constitution and the clinkering process, there are chapters discussing the process of hydration, the setting and hardening of cement, action of acid and sulfate waters, pozzolanic cements, blast-furnace slag cements, aluminous cement, concrete aggregates, resistance of concrete to natural destructive agencies, resistance to organic and inorganic agents, and examination of failures.

In this work there is collected into one volume the most vital information on the subject that has appeared in recent years. The arrangement is logical, and the discussion easily read. A large number of references are given.

The book is to be highly recommended as a comprehensive and up-to-date treatise on the chemistry of cement and concrete.

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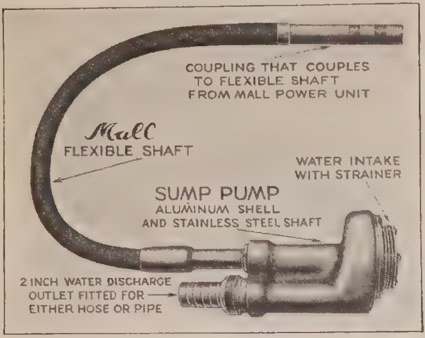
EQUIPMENT AND MATERIALS

THE Mall sump pump is a new type being introduced by the Mall Tool Company, Chicago, Ill., to widen the already numerous applications of their gasoline engine and electric motor power units.

This sump pump is a compact, rugged unit, constructed of non-corrosive materials. It is portable, easily carried by one man. It is designed for pumping out excavations, sumps, caissons, tunnels, trenches, manholes, tanks and coffers and will pump clear or muddy water, sewage or oil with equal efficiency, they claim.


COUPLING THAT COUPLES TO FLEXIBLE SHAFT FROM MALL POWER UNIT
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The Mall sump pump

It is self-priming because the pump itself is submerged directly into the water being pumped. It is non-clogging and discharges 4,500 gallons per hour against a 25 ft. head. Its 2 in. discharge opening can be fitted with either hose or pipe.

It can be operated from any gasoline engine or electric set with vibrator shaft detail by simply coupling flexible shaft furnished with pump to flexible shaft used for vibrating.

●

TUFF-LITE is a light-weight concrete aggregate (expanded slag) developed by the Victor Chemical Works with headquarters in Chicago and works at Nashville, Tenn., and Chicago Heights, Ill. It is produced by a patented process under closely controlled physical conditions.

Tuff-Lite is said to be a fine heat and sound-insulating structural material, to be chemically inert and permanent. Concrete produced from Tuff-Lite aggregate is said to weigh substantially one-third less than that produced from stone or gravel, yet to show strengths meetings practically all specifications; nailing properties are excellent.

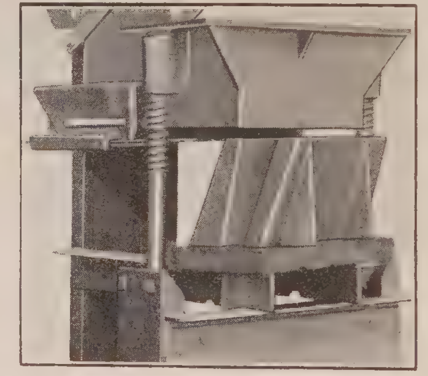
Tuff-Lite is suitable for all types of concrete work and for concrete specialties such as cast-in-place or precast floor slabs, beams, partitions, blocks, tile, roofing units, pipes, septic tanks, burial vaults and boxes, bridge decks telephone and telegraph poles, etc.

AIA File No. 3-D-5 contains considerable information and the results of various tests.

●

THE Stearns "Molder"—a new machine for making manhole cone or batter blocks and other concrete units—is manufactured by the Stearns Manufacturing Co. of Adrian, Michigan, of which Eugene E. Olsen is general manager..

Designed primarily for making cone or batter blocks in manhole and catch basins, the company claims these peculiar shaped units can now be turned out perfectly, rapidly and cheaply. The mold box is one rigid casting, insuring trueness in size and shape. Vertical stripping of the mold box is made possible by use of the loose piece shown in the illustration. This loose piece is left on the pallet until the block is put to rest on the car or curing rack. It is then removed and placed again in the mold box. This procedure prevents the batter block from slumping while it is being carried from machine to curing rack.



Batter block ready to be removed from the molder. Note loose filler-piece on pallet, supporting the green block

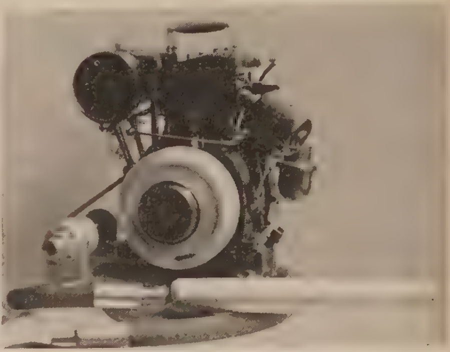
The vertical barrel blocks may also be efficiently made on the Molder.

●

ROETH Model No. 1 flexible shaft gasoline-engine-driven vibrator for internal vibration of concrete has a new specially designed shaft. The shafting is in seven-foot lengths, and three sections with two needle point bearing couplings are furnished.

The shaft casing is constructed of rubber, with three layers of wire fabric and an inside metal flexible tube which prevents grease from coming in contact with rubber. The casing, they say, is built for hard service under severe working conditions. The core, they say, is made up of the finest steel wires having a tensile strength of over 300,000 lbs.

The 4 h.p. 4-cycle, single cylinder, air-cooled Briggs & Stratton gasoline motor, mounted on stainless steel swivel base, is said to be powerful enough to maintain full speed while vibrating dry and stiff concrete mixtures. The motor is equipped with clutch which engages when the engine runs over 1,000 r.p.m., and Allis-Chalmers twin Texsteel sheaves increase the speed in the vibrator up to 7,500 r.p.m.



The Roeth vibrator

Manufacturers' News

CONSTRUCTION Accessories, Inc., is the name of a new engineering and merchandising organization formed to carry on the design, production and distribution of contractors' construction specialties known as the "O.K." line. An extremely varied line of concrete form devices comprises an important part of the company's products. Other specialties include a number of products designed to improve or facilitate building construction.

Their working organization, composed of men of extensive experience in the construction field, is under the management of C. A. Kemper, well known through his former connections with the development and sale of concrete construction specialties.

An engineering service to contractors, on the products they distribute, is a feature of the new company's activities; and with the representatives now being established in principal cities, contractors and engineers are urged to call on them for assistance in preparing details and estimates.

Data sheets on many products they carry are now available, and may be obtained by addressing the company at 2354-64 Ogden Ave., Chicago. The warehouse and machine shops are at the same address.

Construction men or others are invited to send the company any sketches illustrating devices of their own development, for suggestions or negotiations as to their production and distribution.

Vol. XLIII
No. 10

Cement Mill Section of
Concrete

October
1935

How Rotary Cement Kilns Are Insulated

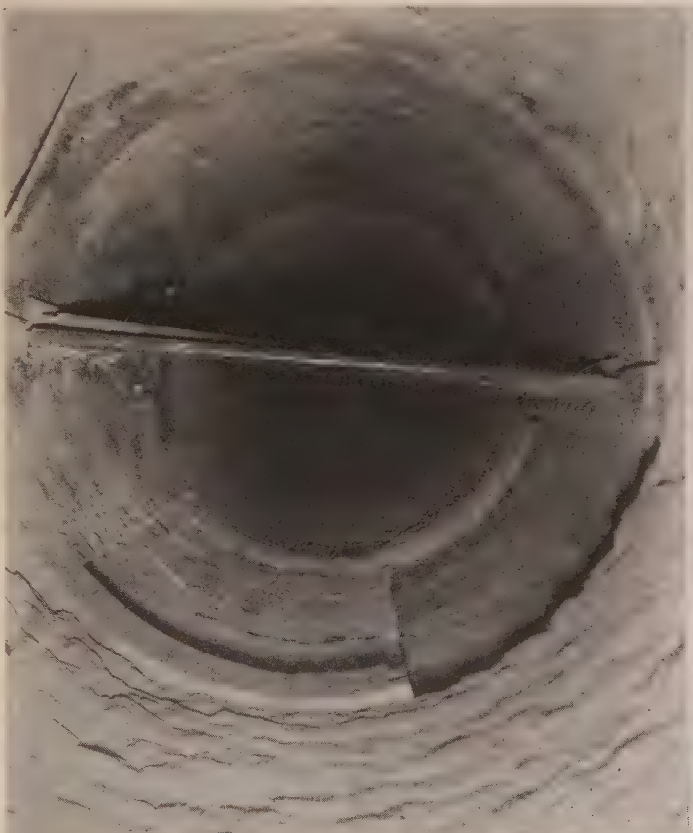
A Method Which Has Proved Successful and the Fuel Economies It Effects—Protection of Kiln Shell Among Other Advantages Gained

By J. C. CRAWFORD, JR.
Staff Engineer, Johns-Manville Corporation, New York, N. Y.

THERE is no other apparatus operating under temperature conditions similar to those encountered in the rotary cement kiln in which the materials used in the lining are subjected to such severe service. In addition to high temperature, there is rotation, vibration, abrasion, expansion and contraction of the fire-brick lining, and the continued impact of the heavy mass of clinker throughout the kiln. In wet-process kilns there is also the effect of water in the slurry.

Taking into account these factors, and the fact that shut-downs due to a hot spot means a loss of several thousand dollars per kiln every 24 hours, it was only natural that for many years authorities were doubtful of the advisability of insulating to reduce excessive heat waste. However, the general utilization of the exit gases in waste-heat boilers for generating electric power, as well as rising fuel costs which called for fuel economy, and the universal efforts toward increased kiln production, all combined to turn the scales in favor of insulation.

It was in the spring of 1924 that the Petoskey Portland Cement Co., at Petoskey, Mich., insulated one of their wet-process kilns with diatomaceous silica and asbestos block insulation. Since then this kiln has operated almost continuously with only the necessary periodical shut-downs for renewing fire-brick at the hot zone where insulation is not installed. On such occasions, an inspection of the insulation revealed it



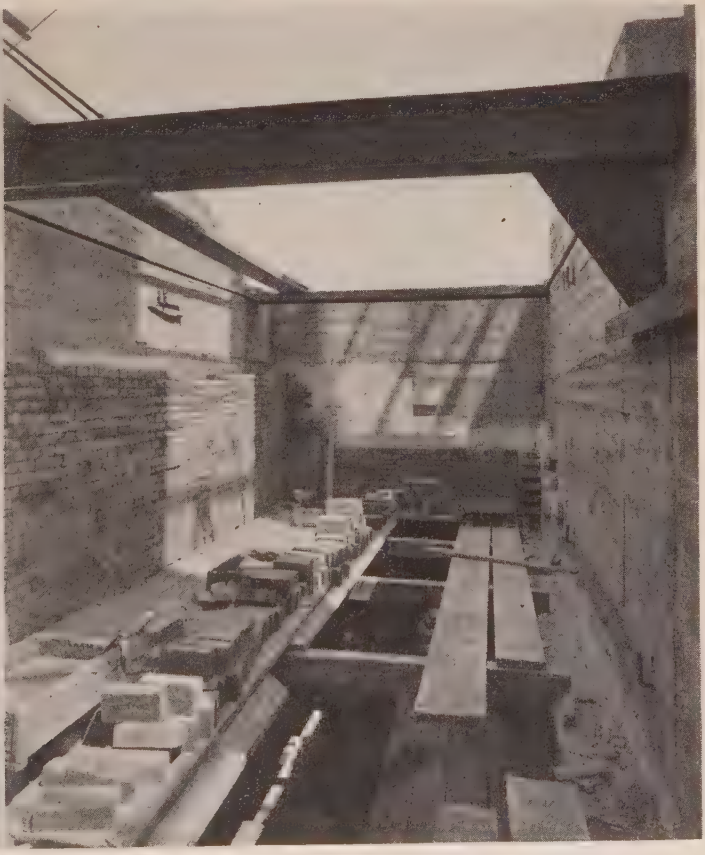
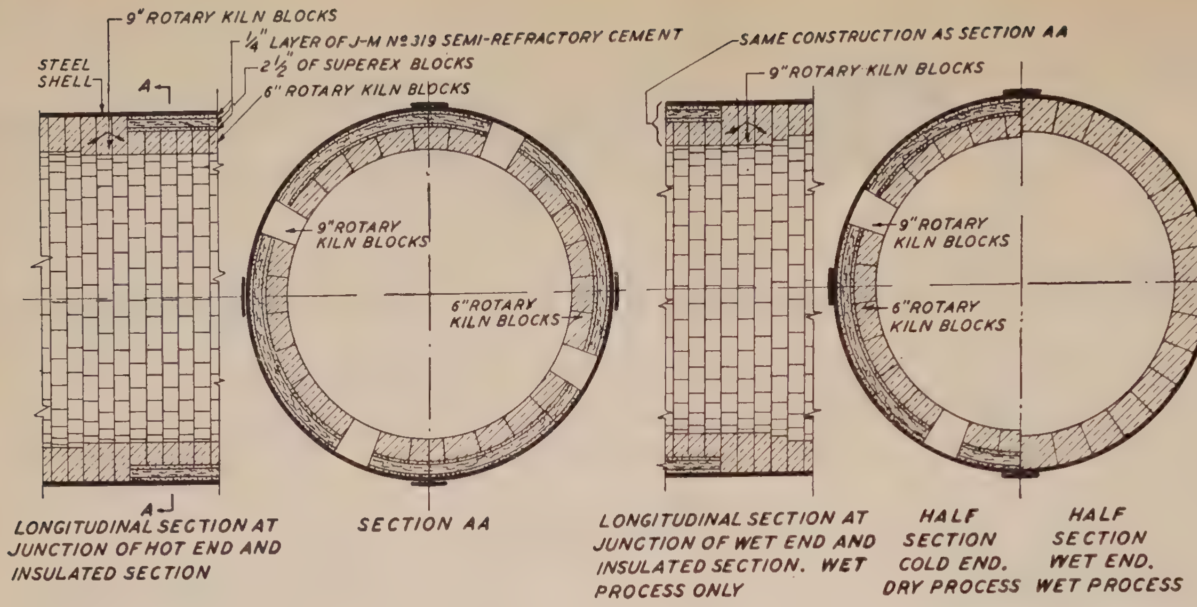


Fig. 1 (Left)—Insulating blocks of diatomaceous silica and asbestos, in rotary cement kiln, showing longitudinal timber and cross-jack method of installation. Fig. 2 (Right)—Waste-heat flue in cement plant being insulated with two 2-in. layers of insulating blocks made of diatomaceous silica and asbestos


9" ROTARY KILN BLOCKS
1/4" LAYER OF J-M No 319 SEMI-REFRACTORY CEMENT
STEEL SHELL
2 1/2" OF SUPEREX BLOCKS
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6" ROTARY KILN BLOCKS
9" ROTARY KILN BLOCKS
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A
LONGITUDINAL SECTION AT JUNCTION OF HOT END AND INSULATED SECTION
SECTION AA
SAME CONSTRUCTION AS SECTION AA
9" ROTARY KILN BLOCKS
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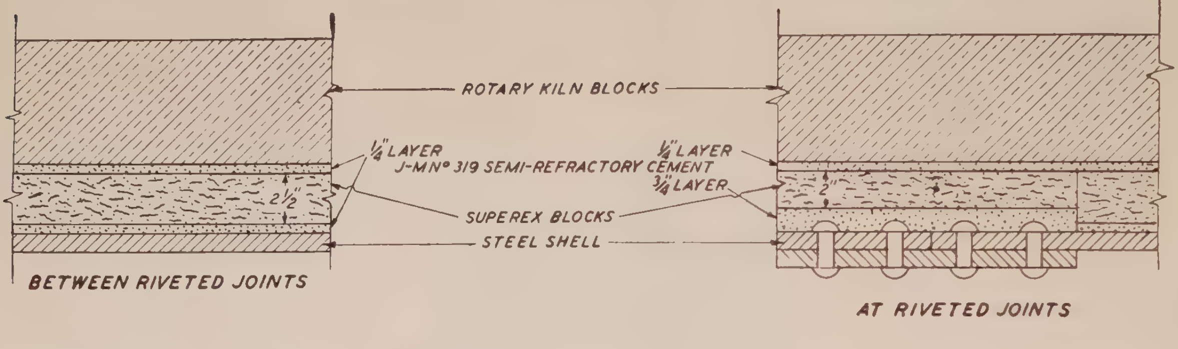
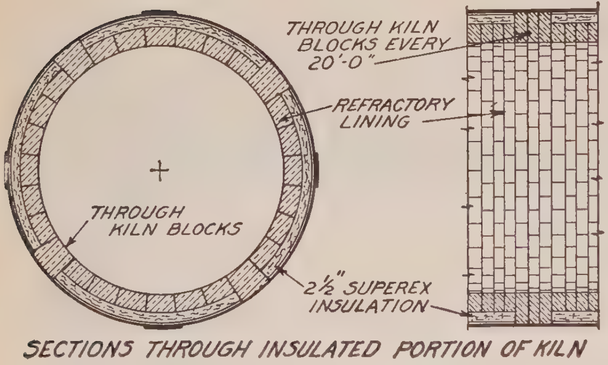
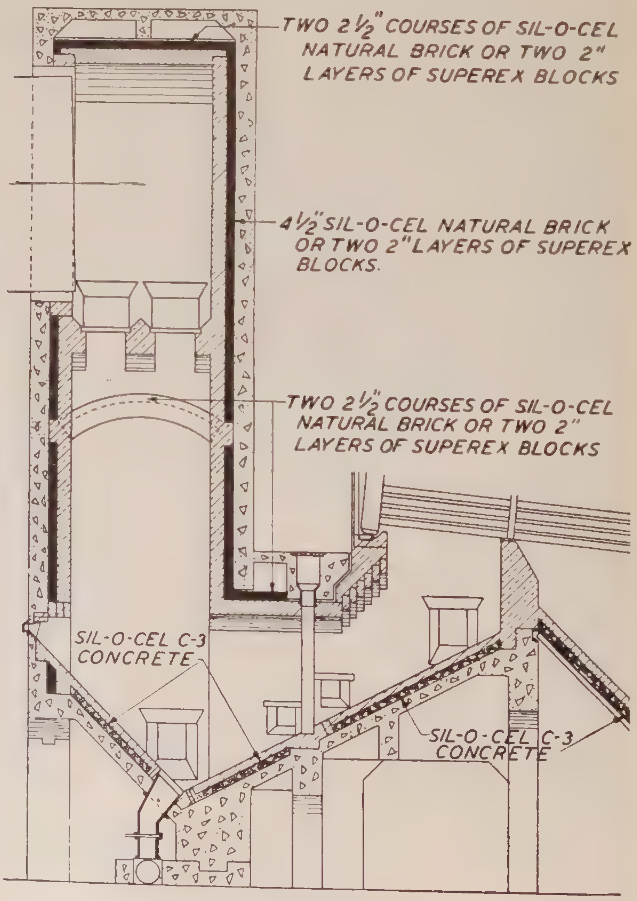



THROUGH KILN BLOCKS EVERY 20'-0"
REFRACTORY LINING
THROUGH KILN BLOCKS
2 1/2" SUPEREX INSULATION
SECTIONS THROUGH INSULATED PORTION OF KILN

Method of insulating high-temperature rotary cement kilns. At lower right-hand is a waste-heat flue insulation


TWO 2 1/2" COURSES OF SIL-O-CEL NATURAL BRICK OR TWO 2" LAYERS OF SUPEREX BLOCKS
4 1/2" SIL-O-CEL NATURAL BRICK OR TWO 2" LAYERS OF SUPEREX BLOCKS.
TWO 2 1/2" COURSES OF SIL-O-CEL NATURAL BRICK OR TWO 2" LAYERS OF SUPEREX BLOCKS
SIL-O-CEL C-3 CONCRETE
SIL-O-CEL C-3 CONCRETE

to be in perfect condition.

Since 1924, as the excellent record of the first kiln became generally known, a great many kilns have been insulated in accordance with specifications similar to those followed in the first installation, and without a single failure, the total number of kilns being about equally divided between wet and dry processes.

Three Major Objectives

In general, there are three major results which may be accomplished by the application of insulation to a rotary cement kiln. They are:

1. Higher flue gas temperatures.
2. Saving in fuel.
3. Increased cement production.

To these may be added the attendant advantages of uniform heat distribution and protection of the kiln shell, as well as more comfortable working conditions resulting from the reduced radiation losses.

As has been stated, it is usually desired to utilize the heat savings which result from insulation to increase the flue gas temperature, without any appreciable increase in production or any pronounced saving in fuel. However, where higher flue temperatures are unnecessary, or even undesirable, as is the case where waste-heat boilers are not used, the savings can be converted into a decrease in fuel consumption with, consequently, no increase in flue temperature.

Saving Fuel

In plants where waste-heat boilers are used, insulation in the kilns and waste-heat flues will increase the temperature of the gases 150 to 250 deg. F. Where waste-heat boilers are not installed, it is possible through insulation to reduce coal consumption from 30 to 60 lb. per ton of clinker.

Where fuel conservation is paramount, a typical instance will demonstrate the economy in insulating the kiln. The heat lost by radiation from a 10-ft. by 200-ft. uninsulated kiln is equivalent to approximtely 9,500,000 B.t.u. per hr. Using pulverized coal with available heat of 10,000 B.t.u. per pound and coal costing $5.00 per ton, the annual loss equals $17,000. By insulating the upper portion of the kiln for a distance of 150 ft., it is possible to save about 50 per cent of this loss, or $8,500 per year.

Other Gains from Insulation

The third variation of the conversion of savings due to insulation is to increase the production, with little, if any, change in fuel consumption or flue gas temperature. In this case, however, the rotation speed of the kiln would in all probability have to be increased.

As a matter of fact, a combination of all three or some two of these results is considered most desirable in the majority of cement plants.

Added to the savings from insulation which can readily be converted into dollars and cents are the more intangible, but still important, results of more uniform heat distribution and kiln shell protection.

There is considerably less variation in temperatures throughout the length of the insulated kiln, and the kiln is less susceptible to outside temperature changes. Air currents also have less effect in increasing heat loss on insulated kilns.

Protecting the Kiln Shell

Insulation materially reduces the temperature on the kiln shell, overcoming to a large degree the expansion stress on the steel plates, the loosening of rivets and the bulges that sometimes occur in an unprotected shell. In a test on rotary kilns having an average inside temperature in the intermediate zone of 1,550 deg. F. in an uninsulated kiln, and 1,750 deg. F. in an insulated kiln, the average external surface temperatures were 640 and 280 deg. F., respectively.

The standard method of insulating high-temperature rotary cement kilns, which was originated by Johns-Manville in 1924 and has since been so continuously successful, is adapted to both dry and wet-process kilns. The details of the method are shown in the drawing.

Omit Insulation at Hot End

In both dry and wet-process kilns, insulation is omitted at the hot end for a distance equal to 25 per cent of the kiln length, or a minimum of 45 ft.

The insulation is terminated flush with the upper end, except in wet-process kilns where filters are not used, in which case the insulation is omitted for a distance of 20 ft. at the wet end.

Throughout the insulated portion of the kiln, 6-in. kiln blocks are used over the insulation, but at each quadrant single longitudinal staggered rows of 9-in. kiln blocks, running the entire length of the insulated portion, are provided to rest against the smooth steel shell without insulation. These longitudinal through-kiln blocks are so placed in order to prevent circumferential slippage of the lining.

To localize longitudinal movements in the lining, three circumferential rows of 9-in. kiln blocks, installed to rest against the smooth steel shell without insulation, are also provided at the junction of the insulated and uninsulated portions, and throughout the length of the insulated portion at intervals of approximately 20 ft.

Records of Fuel Saved

Interesting investigations of the actual savings resulting from insulation strikingly corroborate the pioneer attempt. Records of the fuel consumption at the Clinchfield, Georgia, plant of the Pennsylvania-Dixie Cement Corporation show that a saving of 5 lb. of coal per barrel of cement can be conservatively expected when the standard insulation specification is followed.

In August, 1929, one kiln at Clinchfield was insulated according to the standard method, with 2½-in. insulation. The results obtained led to the insulation of a second kiln in January, 1930. Each kiln is 10 ft. in diameter and 175 ft. long, and has an annual capacity of approximately 360,000 barrels of cement. The wet process is employed, and a pulverized slack coal is used which has a calorific value between 13,000 and 13,500 B.t.u. per lb.

Daily records of coal consumption were carefully kept in order to obtain reliable figures showing the effect of insulation. The average coal consumption per barrel of cement for the year (from August 1, 1928, to August 1, 1929) prior to the time the kilns were insulated amounted to 10 lb. of coal per barrel of cement more than the coal consumption for the year (from February 1, 1930, to February 1, 1931) after the kilns were insulated. Although the saving of 10 lb. of coal per barrel of cement might not all be properly credited to insulation, in all fairness it can be stated that the insulation was a major factor in effecting this saving. Another factor which contributed was a slightly lower moisture content of the slurry. To be very conservative, 50 per cent of the total saving, or 5 lb. per barrel of cement, is credited to the insulation, in the table of actual savings realized.

The total annual saving credited to

the insulation, is 900 tons of coal per kiln, which amounts to $3,330 on the basis of the delivered cost of fuel. The annual charges for the insulation, including depreciation on a conservative three-year basis, average interest on the investment, and an estimated annual allowance of about 10 per cent for maintenance, amount to $945, as shown in the table. After subtracting these charges from the annual cost saving there is a net annual saving of $2,385. This net saving represents an annual return of 120 per cent on the investment in the insulation (including the cost of materials, freight, and labor). The net annual saving on two kilns is $4,770, as tabulated.

Settling Chambers, Waste-Heat Flues and Boilers

When exit gases from the kilns are utilized in waste-heat boilers, insulation of the entire system, including settling chambers, waste-heat flues and boilers, is particularly important.

Settling chambers are usually insulated with $4\frac{1}{2}$-in. brick, or with two 2-in. layers of block insulation between a 9-in. fire-brick lining and an outer wall of concrete. The top is insulated over the fire-brick with the same thickness of insulation as the side wall. In the base, insulating concrete, 4 in. thick, is applied over the regular portland cement concrete and covered with one or two layers of fire-brick. Diatomaceous silica concrete is strong, durable and more than three times as effective as fire-brick in resistance to heat flow.

TABLE OF ACTUAL SAVINGS EFFECTED BY INSULATION

Net saving in coal per barrel of cement, due to the insulation		5.0 lb.
Gross annual coal saving per kiln $\frac{5 \times 360{,}000}{2{,}000}$		900 tons
Gross saving per kiln per year, 900 tons at $3.70		$3,330
Annual charges per kiln for the insulation: Investment—(materials, freight, and labor) $1,995		
Depreciation—$1,995 ÷ 3 yrs.	$665	
Average interest on investment —$1,995 × 4/3 × 0.06/2	80	
Annual allowance for maintenance (estimated)	200	
Total annual charges per kiln		945
Net annual savings per kiln		$2,385
Net annual return on the investment per kiln		120%
Net annual saving on 2 kilns		$4,770

Waste-heat flues are insulated at the sides and tops in the same manner as settling chambers, and to the same thickness. An insulated base is also recommended.

The best evidence that the insulating of rotary kilns is not only satisfactory, but economically justifiable, is the fact that in most cases the insulation of one kiln in a plant has led to following the same procedure when additional kilns were relined or built. Furthermore, the insulated kilns are always used in preference to those uninsulated if the production schedule is such that not all the kilns in the plant are required.

Acknowledgments — The insulating blocks mentioned in this article are a unit made of diatomaceous silica and asbestos, and are known commercially as *Superex* blocks. The insulating bricks mentioned in connection with the insulation of settling chambers, waste-heat flues and boilers, are known as *Sil-O-Cel-Natural Brick;* and the insulating concrete, referred to in the same connection, is a diatomaceous silica known as *Sil-O-Cel C-3*. All these are well-known products manufactured by the Johns-Manville Corporation, of New York.

American Chemical Society Meets at San Francisco

Delegates See Progress on Coast

MORE than 1,100 members and guests registered for the meeting of the American Chemical Society at San Francisco, August 19 to 23. This was only one-fifth the number that registered in New York last April, but there were some compensations. As expressed by one of the members, it was pleasant to have the opportunity of seeing the same persons at least twice during the meeting. As was to be expected, California led in the number of registrants, with 591. Illinois was second, with 62.

The convention turned such a bright search light on California's scientific and industrial accomplishments that climate suffered some neglect as a topic of conversation for a few days. Many papers to be published during the next few months will serve as reminders of these accomplishments.

In a series of interesting papers, the West Coast number of *Chemical and Metallurgical Engineering*, for August, summarizes the wide range of industry in the western states. The papers are grouped under the following heads:

Process industries (including cement and lime).

Raw materials.

Power, fuel, water, and transportation.

Resources and opportunities.

Most of the sessions held by twelve divisions of the Society contained items of interest to the cement manufacturer —if we include research and development; the design, construction, operation, and maintenance of plants; and the great number of uses for the product.

The sessions that should receive special mention to the readers of CONCRETE are those of the Gas and Fuel division, and the *Symposium on Recent Advances in Chemical Thermodynamics*, held by the division of Physical and Inorganic Chemistry (although some individuals might have had more personal interest in the Symposium on the Chemistry and Technology of Wine).

Reject Cement Testing Proposal at St. Louis

A suggested amendment to a pending ordinance which would require all cement used in building or construction in St. Louis, Missouri, whether public or private, to be submitted to the Municipal Testing Laboratory for inspection, was rejected by the Board of Public Service on July 12.

The bill, which was drafted and sponsored by the Board of Public Service, now provides inspection by the laboratory of all cement used on municipal work and sets a fee of 5 cents a barrel to pay costs. The amendment, suggested by Alderman Petersen, would not only include cement used in private work, but would require a fee of 10 cents a barrel for cement contained in sacks and 5 cents for bulk cement, which must be shipped in water-tight steel cement cars. —*St. Louis, Mo., Globe-Democrat.*

Natural and Artificial Pozzolanas

Method of Testing Pozzolanic Substances—Affinity for Lime Is Important—Processed Materials as Artificial Pozzolanas

By **MANUEL DE LOS SANTOS**
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THE first part of this article, printed in the June (1935) issue, pointed out how pozzolanic cements, formerly neglected, have regained favorable consideration for use in concrete construction work in or near sea water, and how this renewed interest has stimulated the search for artificially prepared materials that possess pozzolanic properties. The present part concludes the article, and deals with the methods of testing pozzolanic substances.

CHEMICAL METHOD FOR DETERMINATION OF AFFINITY FOR LIME

We conducted these tests with mixtures of pozzolanas and slaked lime, mixed with water, and keeping the pats in air protected from the action of CO_2—that is, the air was humid and was constantly renewed. From the known proportions of free lime contained in the pats at different periods of elapsed time, it was possible to calculate the power to absorb lime for each pozzolana — that is, its pozzolanic activity. The determination required very little time, having been conducted according to Emley, the values having been obtained by means of the ammonium acetate method and in a solution of pure alcohol and pure glycerine. The test specimens were dried under conditions that provided adequate protection against CO_2 prior to each determination of value.

Blends of Cement and Pozzolana

This same method was applied to cases of blends of cement and pozzolana that were held in suspension in the water, with the object of examining the behavior of the pozzolanas with respect to the absorption of lime which became liberated from the cement. When the mixture was a mortar, we approximated as nearly as possible the conditions encountered in the practical employment of pozzolanas. We gave the mixture the porosity, and consequently more easy access to water, which must be contended with in practical work.

Quantity of Lime Liberated

For the study of the quantity of lime liberated during the hardening of the cements, the method proposed led to excellent results. Each pat of cement was kept in a separate receptacle, submerged in water, with the object of determining the quantity of free lime remaining in the dry pat (Emley), and the quantity that had gone into solution. This determination was effected in this case by means of a generally-accepted volumetric method.

The cement was tested in the pure, or neat, form and in the form of cement-and-sand mortar (1:3 and 1:5), with the object, in the latter case, of approximating more closely the conditions experienced in practice.

Attack by Aggressive Solutions.—As in many cases—and always in this particular method for actuating pozzolanas—the tests that were concerned with chemical determinations could not be accepted as certainties, we have applied also the test of capacity to resist aggressive solutions of high concentration.

Effect of Concentrated Solutions

For this purpose we took a concentrated solution of magnesium sulfate. The substance undergoing test was mixed intimately with air-slaked lime (in proportions of 3 to 1), and a paste was formed by the addition of water. This mixture was left in the mold for 7 days, in moist air, and at the end of this period, after being removed from the mold it was submerged in the magnesium sulfate. At the same time similar operations were conducted with a pozzolana-type material and the study of the process of decomposition gave us extremely interesting data toward establishing the inalterability of the substances.

Other Tests.—Complementary to the tests described were those conducted with mixtures of the pozzolanic materials and cement clinker, these being the cements intended for use in sea water construction. Other tests were made to determine the strength in fresh water, and in a 10 per cent solution of magnesium sulfate, and for the determination of the impermeability of cement-sand mortars made with these cements, in accordance with the method of Anstett, now followed by several laboratories.

Summary.—Inasmuch as not all pozzolanas and analogous substances display their pozzolanic properties in the same form, it is erroneous to expect that fixed, or standard, specifications can be established to cover all of them. For this reason it is necessary to delineate the physical and chemical procedures which, in view of the results, have a bearing on the pozzolanic value of these substances.

It was therefore necessary to take a pozzolana of a known type as a standard for comparison, and to subject it to the same tests, and under identical conditions, as with the substances under examination.

For the standard pozzolana-type we took trass from Andernach, regarded as one of the best natural pozzolanas, and which, in its literature, presents numerous cases of excellent results in important maritime works. We also tested, among others, the pozzolana from the vicinity of Naples, and from the Island of Santorin, to cite some of the best known.

NATURAL POZZOLANAS

With the object of avoiding the accumulation of figures, we think it better to condense from our test notes the general conclusions which some of the pozzolanas merit in view of those tests, and to make certain comments which we judge to be of interest. The data pertaining to these natural pozzolanas are subjected to the same test as those pertaining to thermally treated substances (the artificial pozzolanas), in order that the position of the latter may be established with respect to the natural pozzolanas selected as standard type.

Affinity for Lime

Tests of Vicat.—Pozzolanas and Cold Calcic Solutions.—Trass is the material that shows the highest figures on absorption of lime, higher than the pozzolana from Naples, while that from Santorin falls far behind. The results are discordant, even with the same specimens and under the same conditions of test. With warm solutions (50 deg. C.) the pozzolana from Naples appears to act with greater efficacy than trass—almost twice as effective.

Method of Emley.—Pozzolana and Lime (3:1).—Here the trass disclosed an activity in the absorption of lime greater than that of the pozzolana from

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*Translated from *Cemento* (Barcelona), issue of February, 1935.

Naples, and much superior to that from Santorin. The cements made with the three pozzolanas in equal proportions, in the test for liberation of lime, behaved in very different ways, the pats of trass-portland showing the most favorable figures.

Tensile Strength.—Pozzolana and lime (3:1) were tested at the age of 28 days (7 days in moist air and 21 days in fresh water). The trass showed 156 lb. per sq. in. in tension; Naples pozzolana, 71 lb.; and Santorin, 36 lb.

Action of Magnesium Sulfate.—The test specimens of pozzolana and lime (3:1) were submerged in a concentrated solution of magnesium sulfate, after having been stored in moist air for seven days. The pats made from trass resisted much better than those made from pozzolanas from Naples and Santorin, which began to crack much earlier and almost at the same time.

Results Vary with Test Methods

In these tests of natural pozzolanas there was observed a certain relation which made it possible to establish in a definite manner the superiority of trass over the other two (Naples and Santorin); and as between these two, the higher quality of the pozzolana from Naples is quite evident. It must be granted, however, that these conclusions apply only to the test specimens involved in our investigations, since the difference in quality of pozzolanas from the same source is a fact that is well known.

We wish to point out also the possibility that each pozzolana may respond to some particular test method that brings out its characteristics to the best advantage, and yields the highest results. This is the case with the pozzolana from Naples, which, in the tests of Vicat, shows better figures than trass, the latter being superior to all the rest, particularly so with respect to those which have been involved in the practical employment of pozzolanas.

PROCESSED MATERIALS AS ARTIFICIAL POZZOLANAS

It is not the present intention to obtain artificially-prepared materials which, because of their pozzolanic properties, will serve as substitutes for the natural products, which are found only in certain localities. The preparation of artificial pozzolanas—exclusive of waste products of other industries—comprises various substances which may be classified into two groups. These are the siliceous materials (stone, sand, etc.), and the clays in all their extensive forms, from the chalks, marls, and Fuller's earth, to the clays and clay-marls.

Methods of Heat Treatment

The principl thermal method of treatment of these substances is that of burning them at temperatures somewhere between 600 and 900 deg. C., with variations in the details of the process depending on the pozzolanic qualities of the material under consideration. It is not practicable to publish the methods in general, without considering carefully, in each case, the most convenient process. However, materials such as quartz, when heated to 900 deg. C. and cooled rapidly, do not undergo pozzolanic activation. We do not wish to give the impression here that it is necessary to abandon this field; but in order to realize a possible definite result it will be necessary to work at higher temperatures, and, for the present, with materials of this form, it will be necessary to grind the quartz to the highest degree of fineness.

Dealing with Quartz

In our tests we limited ourselves—in dealing with material such as quartz—to the sizes passing the No. 4 sieve, but we have not obtained wholly satisfactory results. We tried out the addition of some $CaCO_3$ to this siliceous material, with the object of hastening the disintegration by speeding up the decomposition of the carbonate and producing other effects on the silica. The result was not very favorable, and perhaps in this case it was more pronounced by reason of the tendency to produce siliceous cements, as some specialists have pointed out, although this variation of portland cement requires the following of definite principles of manufacture.

We tested the product made from a substance that is rich in silica, burned in the presence of a flux and at high temperatures, with good results; but the process was not economical. We altered some of the details of the test, conducting it with a rock containing 94 per cent of SiO_2, to which had been added 12 per cent of $CaCO_3$ and ½ of 1 per cent of fluorspar, in a thoroughly homogeneous mixture. The test was conducted in two phases with respect to the temperature of calcination, which was 1,100 deg. C. for *Test A* and 1,500 deg. C. for *Test B*. Some figures from the results realized from the two materials are given in Table 1.

TABLE 1

Material	Per cent soluble (Baire)	Tensile strength,* in lb. sq. in.	Action in concentrated solution of magnesium sulfate
A	7	64	Cracks appeared in 7 days
B	4.5	114	No effect

*Specimens were stored 7 days in moist air, and 21 days in fresh water. Proportions were 3 parts of the material and 1 part of lime.

The cement obtained from *Test A*, consisting of two parts of cement clinker and one part of the artificial pozzolana, showed a lower tensile strength than that obtained from *Test B*.

Results with Marls

In this test, as in others, it was observed that the method of Baire (the percentages soluble in dilute acids and alkalis) did not give exact results concerning other properties of the prepared materials, from the standpoint of their capacity as pozzolanas. We continued the tests with other materials—with chalk, plastic clays, and marls. The comparative results are given in Table 2 and Table 3, in which may be found the values as compared with the pozzolana-type, previously mentioned, as well as some values pertaining to the dry marl from Monferrato (Italy), for the samples of which we are indebted to the kindness of Prof. Ferrari.

Old Standards No Longer Apply

A brief consideration of the test results shown in Table 3 confirms the conclusions which we were enabled to deduce from the materials first examined. It seems very difficult, if not impossible, to adhere to the old specifications for the determination of the quality of pozzolanas, especially those which have an artificial origin. It will be advantageous to revise the formulas which have dictated the admission of pozzolanas on the basis of their chemical composition. Neither does the percentage of soluble substances indicate anything specific. The results obtained from the tests of Feret have been disclosed as being subject to error with respect to their value for the determination of the quality of a pozzolanic substance; and in support of this statement we have only to confirm the results obtained by this French investigator. The absorption of lime by the proposed method facilitates the experiment, and determines whether or not a relation exists between this absorp-

TABLE 2—CHEMICAL ANALYSIS OF POZZOLANIC MATERIALS

Number of specimen	Material	Chemical analysis, per cent* SiO₂	Al₂O₃	Fe₂O₃	CaO	MgO	Alkalies	Loss on ignition	Thermal treatment
1	Trass from Andernach	55.64	17.22	5.38	1.64	1.82	9.30	8.98	None
2	Grey pozzolana from Naples	56.25	21.04	5.12	3.42	1.27	4.25	7.92	None
3	Pozzolana from Island of Santorin	64.22	15.38	4.62	4.02	1.86	3.79	5.36	None
4	Quartz rock	94.00	2.63	1.97	0.75	-----	-----	0.24	Burned at 900 deg. C. for 2 hrs. Cooled rapidly.
5	Marl (21% $CaCO_3$)	49.62	18.76	4.16	10.64	1.48	-----	14.12	Burned at 900 deg. C. for 2 hrs. Cooled rapidly.
6	Marl (21% $CaCO_3$)								Calcined at 1,200 deg. C for 2 hrs. Cooled rapidly.
7	Marl (14% $CaCO_3$)	57.27	16.01	6.97	6.24	1.29	-----	9.88	Burned at 800-900 deg. C. for 2 hrs. Cooled rapidly.
8	Marl (14% $CaCO_3$)								Calcined at 1,200 deg. C. for 2 hrs.
9	Clay	63.02	18.13	6.67	1.28	-----	-----	7.92	Both specimens burned at 900 deg. C.
10	Clay								
11	Chalk	58.52	17.88	4.78	5.24	1.42	-----	10.38	Burned at 800-900 deg. C. for 2 hrs.
12	Chalk								Calcined at 1,200 deg. C. for 2 hrs.
13	Marl from Monferrato (Italy)	-----	-----	-----	-----	-----	-----	-----	Received in treated condition.

*Analysis after materials were dried at 105 deg. C.

tion and the dependability of accelerated tests.

Field Greatly Enlarged

The field opened up by these artificial pozzolanas is enormously enlarged. The first thing required is the preliminary work of the laboratory, to establish within reasonable limits the conditions most suitable in each case and with each substance, for the purpose of increasing to the highest degree the pozzolanic activity (Examples: Tables 2 and 3). Then must follow the comparative tests with the standard pozzolana-type.

CONCERNING LIBERATED CALCIUM HYDRATE

Inasmuch as the liberated calcium hydrate is regarded as an important criterion in the acceptance of pozzolanic cements, we believe it a matter of interest to examine this point, even though it may be in a superficial manner.

This free lime has been a subject of much discussion—the discussion extending from those who would allow 28 per cent, to those who would limit it to 3 or 4 per cent. Prof. Hans Kühl has previously said that the quantity of free lime may vary within very wide limits, these limits depending on the quality of the cement, on its fineness, on the quantity of mixing water—following, it is clear, a method of test made under the same conditions, even to the smallest details.

Quantity of Free Lime

The quantity of free lime, expressed as CaO, in modern portland cements in standard neat cement paste, stored in moist air, is around 7.5 per cent in 3 days, and around 8 per cent at the age of 28 days, decreasing to 6.6 per cent at the age of 70 days. These values were obtained by means of tests conducted with cements of various classes and sources. Of course it is necessary to determine in advance of the setting, and from the dry cement, the quantity of free lime, in order to deduce the proportion in the test samples.

Further Experiments Needed

We have previously indicated the details of the method of procedure; but with respect to the results, it will be desirable to gain further experience before arriving at definite conclusions. These values for free lime are those which had been obtained by computation based on the pozzolanic addition made in each case to the cement under consideration. Further investigation is necessary because of the want of a relationship whereby these values will serve as a basis for the computation of the additions, which relationship will serve as a check against the values obtained in the test, of the capacity for absorp-

TABLE 3

Number of specimen	Per cent soluble (Baire)	Tensile strength,* lb. per sq. in.	Penetration** of Vicat needle of 1 kg., in mm.	Grams of lime absorbed per 100 gm. of material tested, in pats of 3:1 proportions, stored in moist air: 3 days	7 days	14 days	21 days	28 days	35 days
1	25.56	170	3	10.55	11.43	11.61	13.55	13.90	13.92
2	24.88	71	5	6.50	8.62	9.90	10.45	11.25	12.08
3	7.08	36	6	3.45	4.30	5.10	7.15	8.55	9.70
4	4.82	28	12	4.25	5.93	7.10	8.15	8.75	8.90
5	17.80	50	6	1.69	3.12	6.15	9.25	10.15	12.65
6	20.30	36	8	5.10	7.12	9.65	11.33	12.14	13.27
7	7.78	43	5	-----	6.30	-----	7.95	9.25	-----
8	12.82	7	14	-----	5.98	-----	7.13	8.50	-----
9	9.58	14	9	6.22	7.31	7.94	8.52	9.21	9.40
10	6.98	14	9	4.12	5.17	5.42	6.31	6.54	6.72
11	14.94	128	4	8.44	10.55	11.08	11.61	14.07	14.29
12	9.78	64	7	5.20	5.33	7.12	9.30	11.23	12.20
13	21.76	-----	–	10.73	11.95	13.02	13.55	13.55	13.72

*At age of 28 days; mixture of 1 part of air-slaked lime and 3 parts of pozzolanic material.
**At age of 7 days; mixture of 1 part of air-slaked lime and 3 parts of pozzolanic material.

tion of lime by the pozzolanas under discussion. In the first place, the conditions under which calcium hydrate is encountered in the cement paste are not the same conditions as in the pozzolanic cements previously prepared. Neither is the rate of lime-absorption the same in the one case as in the other.

Rapid or Slow Cements

Pozzolanic cements which in the early stages of hardening yield a considerable quantity of free lime have an advantage over others which liberate less, when considering the later periods of time. This is in consequence of the distinct method of activating pozzolanic and related materials, which latter, because of their pozzolanic activity, may be classified as pozzolanas — natural or artificial—either *rapid* or *slow*, according to the velocity of lime-absorption.

Referring again to the materials tested by us, German trass and marl from Monferrato are pozzolanas more rapid in their pozzolanic activity (lime-absorption) than the artificial substance shown as No. 11 in Table 3, the latter being also slower than No. 1 in Table 3, but more active in the more prolonged periods of time. This is deduced from the tests conducted with the pozzolana-lime pats.

More Time Required

The period of 30 days for the determination of the quality of pozzolanic cement by means of its liberation of free lime appears to us as being a little too short a period. We think the test should be extended to include longer periods of storage. And as for us, we believe that the greater or lesser rapidity of the pozzolana in the development of its activity (its lime-absorption) is something that must be taken into account when deciding on whether to recommend its use either as cement or in place of the fine aggregate in concrete.

Other Tests Under Way

We have under way a series of tests to determine the liberation of calcium hydrate during the hardening of pozzolanic cements, to which previous reference was made with the suggestion that further study should be made. To return to the subject without prejudice, it appears to us that the liberation of calcium hydrate in pozzolanic cements is a proved basis for the determination of the quality of concrete, as to whether or not it can qualify for use in construction work in sea water or other aggressive solutions. Reference should also be made to the study of the application of the method in the testing of mortars of cement and standard sand, stored in liquids; and also for the purpose of finding here a relation between the liberated lime and the accelerated action of these cements in aggressive solutions.

These are points to be investigated by various laboratories, to the end that we may have the benefit of the valuable data which, through these experiments, would be derived from a problem so great as that of the testing of pozzolanas.

Specific Heat of Raw Materials for Cement

CORRECT values of the specific heats of raw materials are important, and necessary in the calculation of heat balances for rotary kilns. These values have been determined to a higher degree of accuracy than the values previously available, by H. E. Schweite and H. E. von Gronow. Their results, published originally in *Zement* (1935, page 197), have also been printed in *Cement and Cement Manufacture* (August, 1935, page 189), are as indicated in the table.

The results may be interpolated. To find the specific heat of a clay all the Al_2O_3 is taken as kaolin according to the equation kaolin = 2.53 × percentage of Al_2O_3; meta-kaolin = 2.18 × percentage of Al_2O_3. The silica combined with this is equal to 1.18 × percentage of Al_2O_3, and this value is subtracted from the total silica to obtain the free silica. From the table the mean specific heats of these two materials can be read off and the heat content calculated in the usual way. The heat content of the $CaCO_3$ can also be calculated from the specific heat given in the table. The sum of the heats in these three components gives the heat in the raw material. The small amounts of other substances can be neglected without appreciably affecting the result.

SPECIFIC HEAT OF RAW MATERIALS

Degrees Centigrade	$CaCO_3$	CaO	Kaolin	Meta-Kaolin	Air granulated blast-furnace slag	SiO_2 (Wietzel)
20 to 100	0.2087	0.1880	———	———	———	0.1910
” 200	———	———	———	———	———	0.2072
” 300	0.2341	0.2010	0.2684	0.2248	0.2156	0.2196
” 400	0.2435	———	0.2772	0.2341	0.2233	0.2321
” 500	0.2512	0.2057	0.290	0.2414	0.2258	0.2460
” 600	0.2580	———	———	0.2462	0.2301	0.2559
” 700	0.2623	0.2109	———	0.2501	0.2373	0.2587
” 800	0.2644	———	———	0.2540	0.2406	0.2608
” 900	0.2657	0.2129	———	0.2580	0.2434	0.2630
” 1,000	———	———	———	0.2608	0.2458	0.2644
” 1,100	———	0.2153	———	0.2651	0.2498	0.2665
” 1,200	———	———	———	0.2671	0.2565	0.2670
” 1,300	———	0.2170	———	0.2684	0.2773	0.2698
” 1,400	———	———	———	(0.270)	———	0.2704
” 1,500	———	0.2185	———	———	———	(0.2717)

Mineral Trade Notes from Bureau of Mines

THE U. S. Bureau of Mines has started publication of a monthly mimeograph containing a series of notes and comments on the economic and trade aspects of the various metals and industrial minerals (non-metallics) industries. Embodied in the mimeograph are reports from American consular officers, transmitted through the courtesy of the Department of State, supplemented by information from other sources. The service is designed to bring to readers in the United States information that may not be made available promptly in other Government or private publications, including the American trade press.

The first issue, dated July 20, is a review of current data on industrial minerals, other than fuels, and it will be followed by a review on the metals industries and trade. Subsequent numbers will contain monthly inventories of pertinent statistical and factual information on the two principal groups of mineral products.

EDITORIAL

More Than We Expected More cement will be required in WPA construction work than the average cement manufacturer has expected. This fortunate circumstance is due in considerable part of the large volume of street repaving work that is being scheduled under WPA programs, and the further fact that cement-bound macadam paving is now enjoying a nation-wide wave of popularity as a means of salvaging old brick streets.

As mentioned elsewhere in this issue, the city of Chicago alone has scheduled in its WPA program more than 300 miles of repaving work, in which the old bricks of the existing pavements will be broken up and used as aggregate for cement-bound macadam, after the manner described in an article on page 9 of the August (1935) issue of CONCRETE.

This Chicago street-salvaging project alone will require nearly one million barrels of cement—not a mean quantity in the best years!

Portland-Pozzolan Cement An early issue of CONCRETE will carry in condensed form the essential requirements of the type of portland-pozzolan cement specified by the U. S. Engineer Office for use in the construction of Bonneville Dam, the great power-navigation project in the state of Washington.

This type of cement, known also by the more general term of *blended* cement, is produced by the intergrinding of one part of calcined pozzolanic material with three parts (by weight) of standard portland cement clinker.

The purpose of the pozzolanic addition, as always, is that of providing a substance that will combine with the calcium hydroxide normally liberated during the hardening of portland cement concrete. This liberated calcium hydroxide, if not locked up in some other chemical combination, can be dissolved even in ordinary fresh water; and if the finished concrete contains appreciable voids, a channel is provided through which the free calcium hydroxide may be leached out. Eventual disintegration may result, in extreme cases.

With an activated pozzolanic material present, the liberated calcium hydroxide is taken up as rapidly as it is formed, and is converted into a very hard, insoluble lime-pozzolana compound (or lime silicate) that adds materially to the strength of the concrete. At the same time a possible cause of disintegration is removed.

It is fortunate for the cement manufacturing industry that the construction of a number of large dams has brought this question of portland-pozzolan cements to a head. Co-operation between the government engineers and some of the cement companies has resulted in rapid progress toward the solution of the problem—a solution which might have required many years of trial and argument under less favorable circumstances.

After all, the first and most difficult part of the problem was that of knowing what was wanted. That phase seems to be solved, thanks to the co-operative efforts just mentioned. The remaining part of the problem is one of chemistry—and on this point the chemical engineers in the American cement industry are proving themselves well qualified to find the right solution.

The Clean-Up Continues An editorial on this page in the September issue, headed *Running Them Down*, told of disbarment proceedings brought against four St. Louis attorneys who, since 1929, have built up a profitable business as silicosis racketeers.

Two additional attorneys in the same city, engaged in the same racket, now find themselves in serious difficulties. Apparently the long-suffering manufacturers who have been victimized in times past have decided that the best form of defense is a strong attack.

In the prosecution of this attack, suits were filed on September 9 before the St. Louis court of appeals to disbar these two attorneys. The action was based on evidence brought to light during hearings held by the disciplinary committee of the tenth judicial circuit.

Charges brought against them include conspiracy to engage in unprofessional law practice, solicitation of damage suits, employment of runners, and splitting of fees.

The disciplinary committee presented a list of fifty-six damage suits brought by the accused attorneys, in all of which the defendant was either the Universal Atlas Cement Company or the Missouri Portland Cement Company. The further charge was made that the two attorneys had contracts with more than three hundred former employees of the St. Louis plant of one of the cement manufacturing companies.

It is well that these two cement companies have taken this aggressive action, for in doing so they are getting at the source of the trouble. They are helping in the unpleasant task of cleaning out these nests of racketeering lawyers; and with the clean-up completed in St. Louis, similar efforts at Kansas City and Chicago might produce equally good results.

The Chemistry of Cement and Concrete

By **LOUIS A. DAHL**
Research Chemist, Portland Cement Association, Chicago, Ill.

THE literature on developments in cement chemistry during the last few years has been widely scattered. In compiling information on the subject in a discriminating manner the authors of the new book on cement chemistry[1] have a peculiar advantage in the fact that one of the authors was recently engaged in an investigation of the quaternary system lime-alumina-silica-ferric oxide.[2] Since this system includes all of the binary and ternary systems involving these oxides, a systematic study and arrangement of previous knowledge of the subject is made possible.

Laws of Phase Equilibria

In discussing the application of the laws of phase equilibria to problems pertaining to the constitution of portland cement clinker and to the burning of cement raw mixtures the authors adopt a decidedly practical point of view. It is recognized that in the commercial process the course of crystallization may not be the same as in an ideal process in which cooling from the maximum temperature is extended over a long period of time. Examples are given to illustrate the extent to which the phase composition of clinker may differ from that which is computed on the assumption that crystallization is complete. The authors agree with previous investigators that portland cement clinker approximates to an "equilibrium product," but differ in their conception of the particular state of equilibrium which is approached. It is their view that the changes required to attain new equilibrium states as the clinker cools from its maximum temperature occur so slowly that the time available for their occurrence in the commercial process is inadequate. As a result, the cooled clinker may have a phase composition corresponding to that existing at its clinkering temperature, with the melt undercooled to a glass, or the melt may crystallize independently. In the latter case the solid phase $5CaO.3Al_2O_3$ would be present, with the remaining crystalline substances present in proportions somewhat different from those calculated by present methods. It is also held to be possible that part of the melt may crystallize independently, and that the remaining melt may fail to crystallize, and appear as a glass.

The various possibilities mentioned by the authors leave the matter of defining the constitution of an individual clinker in doubt. This does not detract from the value of their work, but indicates that there is need for research on the actual state attained in commercial clinkers. If there are variations in the extent to which crystallization proceeds in the commercial process, methods must be devised for determining or estimating the percentage of glass present. Investigations of the properties of glasses which may occur in portland cement clinker are also in order.

Lime Limit

Referring to the ternary system lime-alumina-silica, the authors call attention to the fact that at equilibrium at clinkering temperatures above 1,470 deg. C. free lime is present in all compositions on the CaO side of the line joining the C_3S point and the quintuple point 1,470 degree C. They state that cooling is probably too rapid to permit the free lime to react with the liquid and thus disappear. This was demonstrated by Spohn in 1932.[3] The line joining the C_3S point and the quintuple point 1,470 deg. C. was designated by him as the "technical lime limit" of portland cement.

The authors set up a lime limit for the quaternary system similar to Spohn's technical lime limit for the ternary system lime-alumina-silica. The plane formed by joining the C_4AF point and the line representing Spohn's lime limit is similarly designated as the "maximum limit to the amount of lime which can be combined by clinkering in the rotary kiln." An equation of this plane is given to represent the technical lime limit in the quaternary system, and to be used as a guide in proportioning portland cement raw mixtures.

Calculating Phase Composition of Clinkers

Equations are given for calculating the phase composition of portland cement clinkers composed of lime, alumina, silica and ferric oxide, on two assumptions: (1) that the state of equilibrium at clinkering temperature is maintained as the clinker cools because of insufficient time for crystallization, all of the liquid phase solidifying as a glass; (2) that the liquid phase does not crystallize in the manner to be expected with extremely slow cooling but crystallizes independently; that is, it crystallizes in the same manner as it would if it were alone, with no solid phases present.

These alternate assumptions represent the limits in phase composition obtainable according to the authors' theory by variations in the extent to which crystallization proceeds. Large variations in C_3S and C_2S are not indicated, but the percentages of C_3A and C_4AF are shown to vary considerably with differences in the rate of cooling from the maximum temperature. According to this theory it is to be expected that properties largely dependent upon the actual C_3S and C_2S content may be predicted with a fair degree of accuracy from the composition of a cement. On the other hand, properties largely dependent upon the actual C_3A or C_4AF contents can not be predicted with any degree of certainty. Studies which have been made of the relation of composition to cement properties seem to give support to the theory. The authors call attention to the fact that factors derived to represent the influence of the potential percentage of C_3A on the strength of cements are erratic.

In those investigations with which we are acquainted the C_3A factors are not erratic, but vary consistently with the time of test. It appears, therefore, that the authors are referring to the fact that the nature of these variations are not the same in the results obtained by different investigators.

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[1] *The Chemistry of Cement and Concrete*, F. M. Lea and C. H. Desch. New York: Longmans Green & Co., 413 pp., 80 figs., 8 plates. $9.50.

[2] Investigation of the Quaternary System $CaO-2CaO.SiO_2-5CaO.3Al_2O_3-4CaO.Al_2O_3-Fe_2O_3$. F. M. Lea and T. W. Parker. Phil. Trans. Royal Soc. of London. Series A, No. 731, Vol. 234. pp. 1-41.

The Quaternary System $CaO-Al_2O_3-SiO_2-Fe_2O_3$ in Relation to Cement Technology. F. M. Lea and T. W. Parker. Building Research, Technical Paper No. 16.

[3] Thesis, Technical University of Berlin, 1932. *Zement*, 21, 702 (1932).

Question of Minor Constituents

The authors express the view that although their equations for calculating phase composition apply strictly only to mixes of the four major oxide constituents of portland cement there is probably no serious error introduced in applying them to mixes containing the minor constituents. This view is open to question. It will be remembered that when the study of the ternary system lime-alumina-silica was completed it was assumed that since these three oxides form about 90 per cent of the total composition of portland cement the remaining components were practically negligible. It is now common knowledge that this is not the case. To illustrate how far a similar conclusion, applied to the quaternary system, may be from the truth, it may be mentioned that if it should be established that the compound $8CaO.Na_2O_3.3Al_2O_3$ is a final product of crystallization in the complete system, each 0.10 per cent of Na_2O will reduce the potential C_3A 1.31 per cent. Furthermore, liquids in the complete system may contain the four major oxide constitutents in relative proportions quite different from those found in the quaternary system, just as significant differences in the relative proportions of lime, alumina, and silica are found upon comparing corresponding invariant points in the ternary and quaternary systems. The value of the splendid work done in the investigation of the quaternary system, and in its interpretation, should give impetus to research aiming at eventually completing the investigation of the entire system of oxide constituents of portland cement clinker, in the range of compositions involved in the clinkering process.

The book is written entirely from the standpoint of the chemist, and deals only briefly with the mechanical testing of cements. Besides the chapters pertaining to raw materials, phase relations, constitution and the clinkering process, there are chapters discussing the process of hydration, the setting and hardening of cement, action of acid and sulfate waters, pozzolanic cements, blast-furnace slag cements, aluminous cement, concrete aggregates, resistance of concrete to natural destructive agencies, resistance to organic and inorganic agents, and examination of failures.

In this work there is collected into one volume the most vital information on the subject that has appeared in recent years. The arrangement is logical, and the discussion easily read. A large number of references are given. The book is to be highly recommended as a comprehensive and up-to-date treatise on the chemistry of cement and concrete.

Belgian Cement Industry Forms Cartel

A RECENT important development in the Belgian cement industry, says the September 20 (1935) issue of *Mineral Trade Notes* (U. S. Bureau of Mines), was the setting up of a cartel of Belgian cement manufacturers.

In response to the Belgian government's appeal in connection with the devaluation of currency, negotiations which had been in progress for several years were terminated successfully, and several agreements are being signed for regulating production and sales and for standardizing the various brands of cement on domestic and foreign markets. The first agreement of the series, dealing with artificial portland cement (by far the most important), was signed on July 10, 1935.

A special joint stock company with a capital of 1 million francs is to be set up to supervise the cement industry. The main object is the repartition of orders among the signators under an agreement which is valid up to 1939. The company will appoint agents to contact cement manufacturers operating in the principal export markets, namely, Netherlands, France and Ireland, and possibly elsewhere.

William W. Hamilton Passes Away

William W. Hamilton, safety director of the Alpha Portland Cement Company since 1929, passed away at Cincinnati on August 27, 1935.

Mr. Hamilton was a leading figure in the safety work of the cement industry and had been an active member of the Committee on Accident Prevention and Insurance of the Portland Cement Association for a number of years. Prior to his selection to head the safety and welfare work of the Alpha Company he had been chief engineer and safety director of the Alpha cement plant at Ironton, Ohio, from the close of the World War. During his tenure at Ironton, Mr. Hamilton built up the safety work of that plant to a point where it won country-wide recognition at a time when extensive rebuilding and repair operations were under way, including a dangerous undertaking in lining the shafts of the plant's limestone mine.

Mr. Hamilton was not only a capable engineer and a skillful director of safety and industrial relations, but he was a man of rare attainments in a number of other lines. During the war he was regarded as one of the most skillful flyers in the entire army service, especially adept with the old Sopwith-Camel plane. He was a graduate in engineering of the University of Cincinnati, a leader in high school, college and professional sports and a member of the city council of Ironton for several years.

Mr. Hamilton died suddenly after a major operation, his death being a surprise and a shock to his many friends.

How Superheated Steam Affects Cement

STUDIES conducted at the New Brunswick Station on the effect of superheated steam on portland cement indicate that highly favorable properties may be brought out by the treatment. During exposure of the cement at a suitable temperature, a small amount of water vapor is absorbed. This renders the cement slow setting even though no retarder be added; it confers plasticity with minimum water requirement; it renders the cement most stable as regards reversion to quick setting; it places the cement approximately in its most favorable state as regards better utilization in hot, dry climates; it allows more general utilization of strength promoters; and develops a superfine cement.—*Mineral Trade Notes,* U. S. Bureau of Mines, Sept. 20, 1935.

Weak Point of Respirators

Difficulty of Breathing Causes Workmen to Cheat—Thinks Face Mask More Practicable in Moderately Dusty Parts of Plant

Editor, CONCRETE: I have just read the item on page 45 of the September issue of your *Cement Mill Edition* concerning the list of respiratory protection devices which have been accorded official approval by the U. S. Bureau of Mines.

We are sufficiently acquainted with the dust situation in the cement manufacturing industry to know that certain circumstances require manufacturers to confine their adoption of protective means to those bearing a Bureau of Mines approval, regardless of the practicability of the protection. The design of the mask manufactured by the company with which I am connected is such that it could not obtain a Bureau of Mines approval when faced with their requirements as to filtration. As these requirements are based upon obtaining a maximum filtration with a small porous pack, the factor of resistance to ordinary respiration becomes rather high. It is our opinion that herein lies the weak point in the general use of this method of protection — not that this is an objection against special use, but it is the great objection against general use.

Our mask is not intended to be used where dust densities are high or where a respirator is absolutely required. The need for a mask such as ours is in parts of the plant where the density of dust is such that operators are tempted to disregard it, due to the discomfort of the respirator.

There is a human limit to withstanding the built-up resistance when using respiratory devices, and it is perfectly human for the wearer to cheat in many little ways, to relieve this resistance. It is in this way that really efficient protective devices become merely an alibi.

In designing our mask we have attempted to produce a means of protection based upon the principle of offering resistance to dust particles without building up resistance to respiration. This is partly accomplished by a cloth covering the entire face, with a 10 by 2-in. cellophane window for clear visibility over 180 deg. of arc. Proper drawstrings attach the mask securely to the top of the forehead, and the lower portion is gathered up under the chin, providing a complete seal for the entire face. Air passes with freedom through the cloth.

When worn, the user is free to talk, hear, and see. A slight discomfort is caused by heat; but the workman becomes accustomed to this, and there is nothing pressing upon the lips or the face to cause irritation. The cellophane window projects the cloth away from the face, leaving a free air space between the face and the mask, of considerable volume.

A mask of this type can be worn all day long without discomfort, and although filtration is low in comparison with other means, in the end its use is justified by continued protection. It is better to have a man wear a mask for eight hours with an efficiency of 25 per cent to 30 per cent than to have him wear a 95 per cent efficient device for only one hour. Manufacturers by insisting upon a Bureau of Mines approval in all cases, may actually be depriving themselves of practical protection.

Perhaps your subscribers will be willing to express their opinions and investigate this means of protection. Naturally we are interested in selling masks of the kind I have been discussing; but we believe that the principle of protection mentioned above is interesting enough to receive users' consideration. It seems to me that there is a clear line that separates the intent to protect, and actual practical protection. I am sure that those manufacturers who are sincerely interested will respond with definite opinions based upon their experiences.

There is very grave danger that manufacturers will get into the habit of relying upon the name of an approved respirator for an alibi.

E. WANGELIN WAGNER,
Vice-President, Stephen M.
Wagner, Inc., 941 Syndicate
Trust Bldg., St, Louis, Mo.

September 10, 1935.

Produce Cement and Pig Iron

THE simultaneous manufacture of cement and pig iron is now accomplished in a plant in Spain by the Basset process. The raw materials are said to be iron ore, coal and limestone. The necessary silica and alumina are present in the ore or in the limestone. Calcination takes place in a dry-process rotary kiln. The molten iron is discharged through a hole, and the cement clinker is delivered at the end of the kiln in the usual manner. Both products are said to be of high quality.—*Mineral Trade Notes*, U. S. Bureau of Mines, Sept. 20, 1935.

New Cement Plant in Idaho Starts Operations

Washington-Idaho Lime Products Company's Mill at Orofino Has Daily Capacity of 400 Barrels

THE new cement manufacturing plant just completed at Orofino, Idaho, by the Washington-Idaho Lime Products Company, Spokane, Wash., has placed its various departments into operation during the past few weeks.

Quarrying and crushing operations were started early in September. By the 20th of the month the raw storage was completely filled, and slurry grinding was started. It is probable that the kiln was started before this article was in print. The cement storage and packing plants are just being completed.

The company has installed one kiln, and with the present installed accessories the plant will have an immediate daily capacity of 400 bbl. By the installation of additional equipment the capacity can be almost doubled.

All raw materials except coal and gypsum are obtained from a natural deposit adjacent to the new plant. The plant itself is designed to handle all materials with the least possible amount of rehandling.

Men and Mills

News of and for Cement Mill Men

A clearing-house page for all kinds of news about cement men and cement mills. ℂ Readers in all mills, even though not regular contributors, are invited to send in news notes about personal and plant activities that may be of interest or value to the men in other mills.

Contracts have been awarded to the following mills for cement for Grand Coulee high dam:

Superior Portland Cement, Inc., Seattle, 1,000,000 barrels; *Northwestern Portland Cement Co.*, Seattle, 450,000 barrels; *Olympic Portland Cement Co., Ltd.*, Seattle, 770,000 barrel; *Lehigh Portland Cement Co.*, Metaline Falls, Wash., 600,000 barrels.

A modified portland cement will be used, which requires a heavy mixture of iron ore and a smaller aluminum content.

The announcement of the award was made by S. O. Harper, acting chief engineer of the Bureau of Reclamation, Denver.

●

Alpha Portland Cement Co., for twelve months ended June 30, reported a net loss of 49 cents a share. This compared with a deficit of 47 cents for the 1934 calendar year, indicating less favorable results in the first half this year than in the corresponding 1934 period. Although a better comparative showing is expected in the final half, profits for the full year will probably be only nominal. Under these conditions, the present $1 dividend cannot be considered secure, although the company's financial position remains strong. Current assets as of June 30 totalled $5,529,190, including $3,623,000 cash items, against $498,707 current liabilities.

●

Alpha Portland Cement Company has awarded a contract to the Joseph Pass Metal Company of Chicago for razing the buildings and salvaging the equipment of the plant at Bellevue, Michigan, which ceased operations about five years ago.

The office building and one or two other buildings will not be dismantled.

●

The Alpha Portland Cement Company's plant at Alsen, New York, reopened recently with a full force of men, following closely the closing of the North American Cement Company's neighboring plant.

The Alpha plant employs about 150 men and had been closed about six weeks.

●

The Hermitage Portland Cement Company of Nashville, Tenn., has been given an order for $1,100 worth of cement for use in Tennessee Valley Authority work at Pickwick and Wheeler dams.—*Mobile, Alabama, Press.*

●

Lehigh Portland Cement Co. declared a dividend of 87½ cents on 7 per cent preferred stock. Giving effect to this distribution, arrears on this issue amount to $10.50 a share.

●

Lehigh Portland Cement operations for the twelve months ended June 30 resulted in a deficit of 83 cents a share, compared with a $2.25 per share deficit in the preceding twelve months. More favorable comparisons should be made over coming months, as additional public works contracts are allotted under the federal work-relief program. Earnings for the full year should approximate or exceed those of last year, despite somewhat higher production costs. The deficit for the full year 1934 was 44 cents a share. A strong financial position has been maintained.

●

Marquette Cement Manufacturing Company employees at a meeting recently of the newly organized union were formally presented with their charter as an affiliated local of the United Cement Workers' union by William Schoenberg, of Chicago, an organizer for the American Federation of Labor.

Officers elected during the meeting include John McGraw, president; Robert Pioli, vice-president; Felix Butkus, recording secretary; Ed. Wolfe, financial secretary; William Corless, treasurer; Peter Ingenoli, inner guard; John Mussetti, guide; Thomas Shields, Anton Jereb and William Jones, trustees.

Mr. McGraw stated that there are 561 employees listed in the membership rolls of the new union, these taking in the entire working force of the Marquette company.—*La-Salle, Ill., Post.*

●

Marquette Cement Manufacturing Company announced at its offices in Chicago a call for redemption on October 1, 1935, of all its outstanding first mortgage serial bonds.

Two series of bonds are outstanding, one carrying a 6 per cent interest coupon and the other a 5 per cent coupon. The maturities of the called bonds run serially to October 1, 1945, from October 1, 1936, the aggregate principal amount being $2,675,000.

●

Marquette Cement Manufacturing Company resumed operations at the Oglesby (Illinois) plant on August 15, after a 31-day suspension during which new coal pulverizing equipment was installed. Approximately 500 men are employed.

●

F. L. Stone, vice-president and general sales manager of the *Universal Atlas Cement Company* announces the following new appointments:

R. M. Beaton, district sales manager, New York, in charge of metropolitan New York and northern New Jersey territory.

B. J. Whittaker, district sales manager, Albany, in charge of New York state territory.

C. L. Whalley, assistant district sales manager, Newark.

All the new appointees are under the direction of *A. O. Stark*, sales manager, New York.

●

When the Universal (Pa.) plant of the *Universal Atlas Cement Company* recently rededicated the Portland Cement Association safety trophy, won for a perfect year of safety in 1934, a group of "old-timers," whose total length of service amounts to 577 years, was the center of attraction. They are *Fred Hann, Herbert Lord, Roy L. Slocum, David W. McFayden, John Conlon, Nick Boichan, Joseph Strejcek, Thomas Blaskovitch, Luman F. Wittenberg, George Buckingham, Lawrence F. Doyle, John J. O'Malley, Fred Smith, Edmund D. Barry, John Campbell, William J. Bain, Ernest H. Loveday, Andrew J. McFarland, John Piposzar, George Koscso and John Dobos.*

●

Wabash Portland Cement Company's plant at Stroh, Indiana, closed about the middle of August. The plant employed 185 men.

●

Heavy Cement and Steel Movement to Cartagena

Some interesting tonnages of cement and steel articles will be moving out of New York to Cartagena as evidenced by rates just fixed by the East Coast Columbian Steamship Lines Conference. On cement in bags, a rate of 21½ cents has been established with a movement of 8,500 tons in prospect. The rates are to hold up to June 30 next.

●

It Starts Like Pneumonia

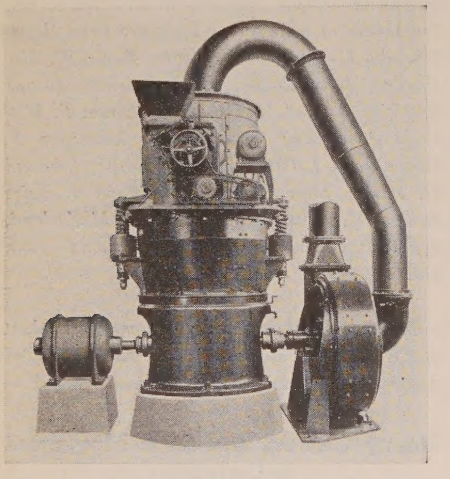
The puzzlers have a word for it and it is—take a deep breath—pneumonoultramicroscopicsilicovolcanokoniosis.

That forty-five letter word has replaced electrophotomicrographically, a mere upstart of twenty-eight letters, as the longest word in the English language recognized by the National Puzzlers' League. It's the name of a special form of silicosis caused by ultramicroscopic particles of siliceous volcanic dust.—*Chicago Tribune.*

MILL EQUIPMENT

RAYMOND Bowl Mill, just announced by Raymond Bros. Impact Pulverizer Company of Chicago, has been under development for a considerable period and they say it has been subjected to extended service tests. Its design makes for low friction losses, hence low power consumption, quiet running and low maintenance, because of no metal-to-metal contact between the bowl and the rolls. Adjustment may be made from the outside while the mill is running. The speed is constant with the output controlled by varying the rate of feed. Mill power is almost directly proportional to the load. The mill is adapted both to direct firing and to storage systems in coal grinding operations. It is also highly efficient, they say, for pulverizing many other non-metallic minerals.

The unique feature of the mill is a revolving bowl or grinding chamber. Due to centrifugal force, the coal which is ground between the reduction rolls and the grinding ring, works its way up the inclined walls of the bowl. As the ground particles reach the rim, the fines and intermediate sizes are picked up by the air current coming up from the annular spaces around the bowl, and are carried into the separator above for further classification. As the finished material is separated out, the oversize particles drop back and re-enter the mill with the raw feed.

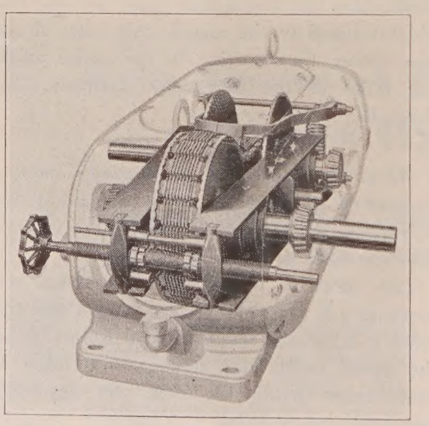

The Raymond bowl mill. The bowl revolves on a vertical shaft, mounted on roller bearings and is driven through a worm gear by a horizontal main shaft, direct-connected to a constant-speed standard motor

The rolls are held in a fixed position by the heavy journal heads, supported on trunnions that rest on the top plate of the mill. Clearance between the rolls and the revolving bowl may be adjusted from the outside while the mill is running. The journal heads are connected through arms to the roll pressure springs and adjustment rods, mounted in cast-iron lugs outside the mill casing.

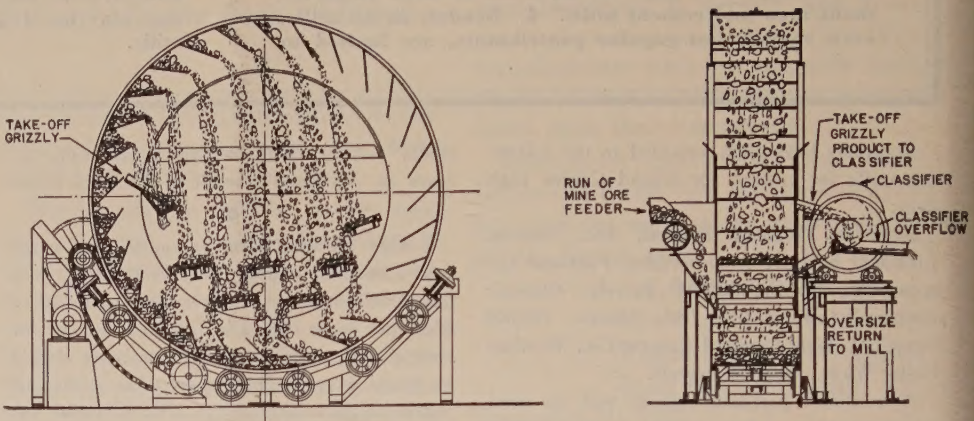
The mill parts are protected from damage resulting from tramp iron or other ungrindable material by a positive means of disposal. The pressure springs allow pieces of iron to pass the rolls without injury, and when the tramp iron reaches the top of the bowl, it is thrown into the annular space below and expelled by revolving plows through a discharge.

◆

LINK-BELT Company announces that in order to meet the growing demand for still greater range and flexibility of application, certain features of design have recently been incorporated in its P.I.V. gear variable speed transmission, which will permit the entire line to be furnished in the following combinations and sizes: (1) Motorized (when desired) with motor forming an integral part of the unit. (2) With or without speed reduction gearing. (3) With horizontal or vertical box. (4) And in 5 sizes up to 15 h.p. capacity.


Link-Belt's modernized variable speed transmission

A new Book No. 1574 has been prepared to cover the new combinations and capacity range of P.I.V. gears available.



Principle of operation of Hardinge-Hadsel mill

HARDINGE-HADSEL mill, which has been under development by the Hardinge Company, Incorporated, of York, Pennsylvania, during the past four years, is covered in bulletin Ah-323. The mill is said to work under all conditions and under different types of ores, as well as to establish a definite basis upon which operating costs could be figured.

The bulletin specifically describes the Kootenay-Belle mine and mill installation in British Columbia, and also gives data and specifications on various mill sizes, illustrates different installations and gives comparative crushing and grinding costs between the conventional crusher-ball mill combination and the Hardinge-Hadsel mill, which shows that the overall grinding cost, including labor, power, repairs and maintenance, grinding from run of mine ore about 12 in. in size feed, to 200 mesh, is just about half that of the crusher-ball mill combination, using the same general basis for power cost, labor cost, etc.

Industrial Literature

"THERMIT WELDING—Industry's Master Maintenance Tool," is the title of a new illustrated 16-page booklet just published by the Metal & Thermit Corporation, New York City.

The booklet describes Thermit Welding, an alumino-thermic process which has been successfully employed, they say, for more than thirty years in the welding of heavy sections of ferrous metals. The actual welding of railroad track and the repair of large machine parts, huge castings, crankshafts, and similar articles by the Thermit Process are covered.

◆

DUST Collection and Elimination is the title of an 8-page booklet published by the Buell Engineering Company, Inc., New York City, describing the Van Tongeren system.